PB80-223092

Treatability Manual
Volume V: Summary

(U.S.) Environmental Protection Agency
Washington, DC

Jul 80

U.S. Department of Commerce
National Technical Information Service
NTIS

BIBLIOGRAPHIC INFORMATION

PB80-223092

Treatability Manual. Volume V: Summary.

Jul 80

PERFORMER: Environmental Protection Agency, Washington, DC.
Office of Research and Development.
EPA-600/8-80-042E

See also Volume 4, PB80-223084. Also available in set of 5 reports PC E99, PB80-223043.

The Treatability Manual presents in five volumes an extensive survey of the effectiveness of various water pollution treatment processes when applied to particular industrial effluents. This volume summarizes volumes one through four and outlines their potential utility to National Pollutant Discharge Elimination System (NPDES) permit writers.

KEYWORDS: *Waste water, *Water pollution control.

Available from the National Technical Information Service, Springfield, Va. 22161

PRICE CODE: PC A09/MF A01

PB80-223092

EPA-600/8-80-042e

TREATABILITY MANUAL

VOLUME V. Summary

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

July 1980

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

PREFACE

In January, 1979, EPA's Office of Enforcement and Office of Water and Waste Management requested help from the Office of Research and Development in compiling wastwater treatment performance data into a "Treatability Manual". This Manual was to be used in developing NPDES permit limitations for facilities which, at the time of permit issuance, were not fully covered by promulgated, industry-specific effluent guidelines authorized under Sections 301, 304, 306, 307, and 501 of the CWA.

A planning group was set up to manage the treatability program under the chairmanship of William Cawley, Deputy Director, Industrial Environmental Research Laboratory - Cincinnati. The group includes participants from: 1) the Industrial Environmental Research Laboratory - Cincinnati, 2) Effluent Guidelines Division, Office of Water and Waste Management; 3) Permits Division, Office of Enforcement; 4) Municipal Environmental Research Laboratory - Cincinnati; 5) R. S. Kerr, Environmental Research Laboratory - Ada; 6) Industrial Environmental Research Laboratory - Research Triangle Park; 7) Monsanto Research Corporation; and 8) Aerospace Corporation.

The objectives of the treatability program are:

- To provide readily accessible data and information on treatability of industrial and municipal waste streams for use by NPDES permit writers, enforcement personnel, and by industrial or municipal permit holders;
- To provide a basis for research planning by identifying gaps in knowledge of the treatability of certain pollutants and wastestreams;
- To set up a system allowing rapid response to program office requirements for generation of treatability data.

The primary output from this program is a five-volume Treatability Manual. The individual volumes are named as follows:

Volume I - Treatability Data
Volume II - Industrial Descriptions
Volume III - Technologies
Volume IV - Cost Estimating
Volume V - Summary

Date: 6/23/80

ACKNOWLEDGEMENT

The sheer size and comprehensiveness of this document should make it obvious that this had to be the effort of a large number of people. It is the collection of contributions from throughout the Environmental Protection Agency, particularly from the Office of Enforcement, Office of Water and Hazardous Materials and the Office of Research and Development. Equally important to its success were the efforts of the employees of the Aerospace Corporation, MATHTECH, INC., and the Monsanto Research Corporation who participated in this operation.

No list of the names of everyone who took part in the effort would in any way adequately acknowledge the effort which those involved in preparing this Manual made toward its development. Equally difficult would be an attempt to name the people who have made the most significant contributions both because there have been too many and because it would be impossible to adequately define the term "significant." This document exists because of major contributions by the contractor's staff and by members of the following:

Effluent Guidelines Division
    Office of Water and Waste Management

Permits Division
    Office of Water Enforcement

National Enforcement Investigation Center
    Office of Enforcement

Center for Environmental Research Information

Municipal Environmental Research Laboratory

Robert S. Kerr Environmental Research Laboratory

Industrial Environmental Research Laboratory
    Research Triangle Park, NC

Industrial Environmental Research Laboratory
    Cincinnati, OH
    Office of Research and Development

The purpose of this acknowledgement is to express my thanks as Committee Chairman and the thanks of the Agency to the Committee Members and others who contributed to the success of this effort.

William A. Cawley, Deputy Director, IERL-Ci
Chairman, Treatability Coordination Committee

Date: 6/23/80

SECTION V.1

INTRODUCTION

The Treatability Manual presents in five volumes an extensive survey of the effectiveness of various water pollution treatment processes when applied to particular industrial effluents. This volume summarizes volumes one through four and outlines their potential utility to National Pollutant Discharge Elimination System (NPDES) permit writers.

V.1.1 OBJECTIVES

The Treatability Manual is intended for use by NPDES permit writers, along with other information, to:

- Evaluate the potential effectiveness and costs of proposed effluent treatment systems,
- Determine the potential cost and feasibility of compliance with discharge limitations under consideration, and
- Develop the wastewater pollution control and monitoring requirements to be employed at specific sites.

This Manual is not intended to:

- Specify the final effluent concentrations to be required for industrial processes,
- Address "in process" controls,
- Describe wastewater recycling or reuse systems (although their existence is mentioned in Volume II, when such information was provided in the literature),
- Contain an exhaustive study of pollution removal efficiencies or the reliability and applicability of control equipment,
- Define methods or costs for the disposal of by-products of water pollution control, such as solid waste or air pollution, or
- Characterize the suitability of wastewater pollution control equipment and auxiliary processes for meeting air pollution regulations and RCRA regulations.

Nevertheless, this Manual does provide background information on some of these issues for consideration by a permit writer. This, along with other data, may be useful when calculating "best engineering judgment" limits for second-round permits which reflect Best Available Technology for toxic pollutants.

V.1.2 DATA SOURCES

Part A of the bibliography in this volume includes all references used in Volumes I through IV of the Manual. All of these references are available in a central file located at:

U.S. Environmental Protection Agency
Municipal Environmental Research Laboratory
First Floor Library
26 West St. Clair Street
Cincinnati, Ohio 45268

To avoid potentially repetitious literature searches, all other sources examined during this study not containing information considered relevant to this effort are listed in Part B of the bibliography.

V.1.3 GUIDE TO VOLUME V

Subsequent sections of this document are organized as follows:

- Section 2 (Executive Summaries of Volumes I through IV). Summarizes the contents of Volumes I through IV.
- Section 3 (Guidance for Use) provides advice on how the information provided may be used during the NPDES permit writing process.
- Section 4 (Indicators) covers the concept of indicator pollutants and contains a table showing some examples of potential indicators for various pollution treatment technologies.
- The Bibliography shows all references studied during preparation of Volumes I through IV. Part A covers all references used, and Part B covers references examined but not used.
- Appendix A (Number of Source/Treatment Technology Data Sets) shows the number of effluent test data sets available for various combinations of industrial processes and control technologies.
- Appendix B (Median Observed Effluent Concentrations) shows the median observed effluent concentration for various pollutants, segregated by control technology.
- Appendix C (Median Removal Efficiencies) shows the median observed removal efficiency of different control technologies for various pollutants.

CONTENTS

Page

Figures vi
Tables vi
Acknowledgement iii

V.1 Introduction V.1-1
  V.1.1 Objectives V.1-1
  V.1.2 Data Sources V.1-2
  V.1.3 Guide to Volume V V.1-2

V.2 Executive Summaries of Volumes I Through IV V.2-1
  V.2.1 Volume I - Treatability Data V.2-1
  V.2.2 Volume II - Industrial Descriptions V.2-2
  V.2.3 Volume III - Technologies for Control/Removal of Pollutants V.2-2
  V.2.4 Volume IV - Cost Estimating V.2-3

V.3 Guidance for Use V.3-1
  V.3.1 General Information V.3-1
  V.3.2 Stepwise Approach for Using This Manual V.3-4

V.4 Indicators V.4-1

V.5 References V.5-1

V.6 Bibliography V.6-1
  A. References Used in Volumes I-IV V.6-1
  B. References Examined But Not Used V.6-17

Appendices
  A. Number of Source/Treatment Technology Data Sets . . V.A-1
  B. Median Observed Effluent Concentrations V.A-8
  C. Median Removal Efficiencies V.A-29
  D. Pollutant Treatability Index V.A-50

Glossary V.A-128

FIGURES

Number		Page
1	Treatment technology overview.	V.2-4

TABLES

Number		Page
A-1	Number of Source/Treatment Technology Data Sets. .	V.A-2
B-1	Median Observed Effluent Concentrations.	V.A-10
B-2	Median Observed Effluent Concentrations.	V.A-15
B-3	Median Observed Effluent Concentrations.	V.A-20
B-4	Median Observed Effluent Concentrations.	V.A-25
C-1	Median Removal Efficiencies.	V.A-31
C-2	Median Removal Efficiencies.	V.A-36
C-3	Median Removal Efficiencies.	V.A-41
C-4	Median Removal Efficiencies.	V.A-46
D-1	Pollutant Treatability Index	V.A-52

GLOSSARY

AAP: Army Ammunitions Plant.

AN: Ammonium Nitrate.

ANFO: Ammonium Nitrate/Fuel Oil.

BATEA: Best Available Technology Economically Achievable.

BAT: Best Applicable Technology.

BDL: Below Detection Limit.

BEJ: Best Engineering Judgement.

BOD: Biochemical Oxygen Demand.

clarification: Process by which a suspension is clarified to give a "clear" supernatant.

cryolite: A mineral consisting of sodium-aluminum fluoride.

CWA: Clean Water Act.

cyanidation process: Gold and/or silver are extracted from finely crushed ores, concentrates, tailings, and low-grade mine-run rock in dilute, weakly alkaline solutions of potassium or sodium cyanide.

comminutor: Mechanical devices that cut up material normally removed in the screening process.

effluent: A waste product discharged from a process.

EGD: Effluent Guidelines Division.

elutriation: The process of washing and separating suspended particles by decantation.

extraction: The process of separating the active constituents of drugs by suitable methods.

fermentation: A chemical change of organic matter brought about by the action of an enzyme or ferment.

flocculation: The coalescence of a finely-divided precipitate.

fumigant: A gaseous or readily volatilizable chemical used as a disinfectant or pesticide.

GAC: Granular Activated Carbon.

gravity concentration: A process which uses the differences in density to separate ore minerals from gangue.

gravity separation/settling: A process which removes suspended solids by natural gravitational forces.

grit removal: Preliminary treatment that removes large objects, in order to prevent damage to subsequent treatment and process equipment.

influent: A process stream entering the treatment system.

intake: Water, such as tap or well water, that is used as makeup water in the process.

lagoon: A shallow artificial pond for the natural oxidation of sewage or ultimate drying of the sludge.

LAP: Loading Assembly and Packing operations.

MGD: Million Gallons per Day.

MHF: Multiple Hearth Furnace.

NA: Not Analyzed.

ND: Not Detected.

neutralization: The process of adjusting either an acidic or a basic wastestream to a pH near seven.

NPDES: National Pollutant Discharge Elimination System.

NRDC: National Resources Defense Council.

NSPS: New Source Performance Standards.

photolysis: Chemical decomposition or dissociation by the action of radiant energy.

PCB: PolyChlorinated Biphenyl.

POTW: Publicly Owned Treatment Works.

PSES: Pretreatment Standards for Existing Sources.

purged: Removed by a process of cleaning; take off or out.

screening process: A process used to remove coarse and/or gross solids from untreated wastewater before subsequent treatment.

SIC: Standard Industrial Classification.

SS: Suspended Solids.

SRT: Solids Retention Time.

starved air combustion: Used for the volumetric and organic reduction of sludge solids.

terpene: Any of a class of isomeric hydrocarbons.

thermal drying: Process in which the moisture in sludge is reduced by evaporation using hot air, without the solids being combusted.

TKN: Total Kjeldahl Nitrogen.

TOC: Total Organic Carbon.

trickling filter: Process in which wastes are sprayed through the air to absorb oxygen and allowed to trickle through a bed of rock or synthetic media coated with a slime of microbial growth to removed dissolved and collodial biodegradable organics.

TSS: Total Suspended Solids.

vacuum filtration: Process employed to dewater sludges so that a is produced having the physical handling characteristics and contents required for processing.

VSS: Volatile Suspended Solids.

WQC: Water Quality Criterion.

- Appendix D (Pollutant Treatability Index) covers the lowest observed effluent concentration and the highest observed removal efficiency for various pollutants and control technologies, with references to sources of more detailed information in Volume III.
- The Glossary defines those abbreviations and terms used in all five volumes of the Manual that might not be readily known.

SECTION V.2

EXECUTIVE SUMMARIES OF VOLUMES I THROUGH IV

V.2.1 VOLUME I - TREATABILITY DATA

Volume I is a compendium of treatability data for specific pollutants. Information is provided on the compounds listed in the Draft Consolidated Permit Application Form 2C (NPDES) Section V, Part B (44 FR 34361, 6/14/79) [3] and the compounds listed in Table 1, 44 FR 50781, August 29, 1979. The pollutants covered were organized into the following chemical categories:

- Metals and inorganics
- Ethers
- Phthalates
- Nitrogen compounds
- Phenols
- Aromatics
- Polynuclear aromatic hydrocarbons
- PCB's and related compounds
- Halogenated hydrocarbons
- Pesticides
- Oxygenated compounds
- Miscellaneous

The following information is provided for each pollutant:

- Alternate names of the chemical;
- Chemical Abstracts Number;
- Physical, chemical, and biological properties, including molecular weight, melting point, boiling point, vapor pressure, solubility in water at 20°C, log octanol/water partition coefficient (relevant to bioaccumulation), Henry's Law constant (reflecting ease of "stripping"), and biodegradability data;
- Probable fate of the compound in the aqueous environment. Removal processes considered include photolysis, oxidation, hydrolysis, volatilization, sorption and biological processes;
- Data on the effectiveness of activated carbon to control the material;

- Industrial occurrence of the material. Minimum, maximum, and mean concentrations are reported for both untreated and treated wastewater for each industry in which the substance has been detected; and
- Average and maximum removal efficiencies and average effluent concentrations for specific control technologies.

V.2.2 VOLUME II - INDUSTRIAL DESCRIPTIONS

Volume II contains a general description of each of the "primary industries" named in the "NRDC Consent Agreement" (Natural Resources Defense Council versus Russell E. Train, 8 ERC 2120 [D.D.C. 1976] amended on March 1979) and their major subcategories. It also includes:

- Subcategory-wide or industry-wide tables covering,
    - the number of dischargers,
    - the types of pollution control systems in use,
    - the range of effluent flow rates and pollutant concentrations in controlled and uncontrolled waste streams, and
    - the efficiency of control systems, when available;
- Summary tables on BPT effluent guidelines and the status of BAT guidelines, New Source Performance Standards, and Pretreatment standards; and
- Tabulated information on individual plants specifying industrial subcategory, control systems (including operating characteristics when available), effluent concentrations, and influent concentrations when available.

If recycling, reuse, or subsurface injection of wastewater is practiced at a plant, this is noted in the plant-specific table; but no details are included.

V.2.3 VOLUME III - TECHNOLOGIES FOR CONTROL/REMOVAL OF POLLUTANTS

Volume III summarizes information on the nature and effectiveness of various pollution control technologies. It describes the nature of the generic type of control equipment, the major variations of design, and information on the following:

- Design criteria for the process;
- Typical performance of the process;
- Applications and limitations of the process;
- Reliability of the process;
- Chemicals required to operate the process; and
- Environmental impacts of the process.

A summary table for each technology is also provided showing the concentrations of the various pollutants in the effluents, the minimum, maximum, median, and mean removal efficiencies, and the number of data points used to generate this information. Data sheets summarizing the results of tests at specific installations are also included.

Pollution control systems have been classified as:

- Primary - designed to remove suspended solids and colloidal materials;
- Secondary - designed to remove dissolved organics; and
- Tertiary - designed to remove residual organics and dissolved inorganics.

Although exceptions exist, tertiary treatment systems usually operate more reliably and economically on wastewater effluent streams that have received secondary treatment. Secondary treatment systems usually work best on wastewater effluent streams that have received primary treatment.

Figure V.1 summarizes the wastewater treatment options available for pollution control. Treatment options for sludges and liquid by-products of water pollution control are also shown.

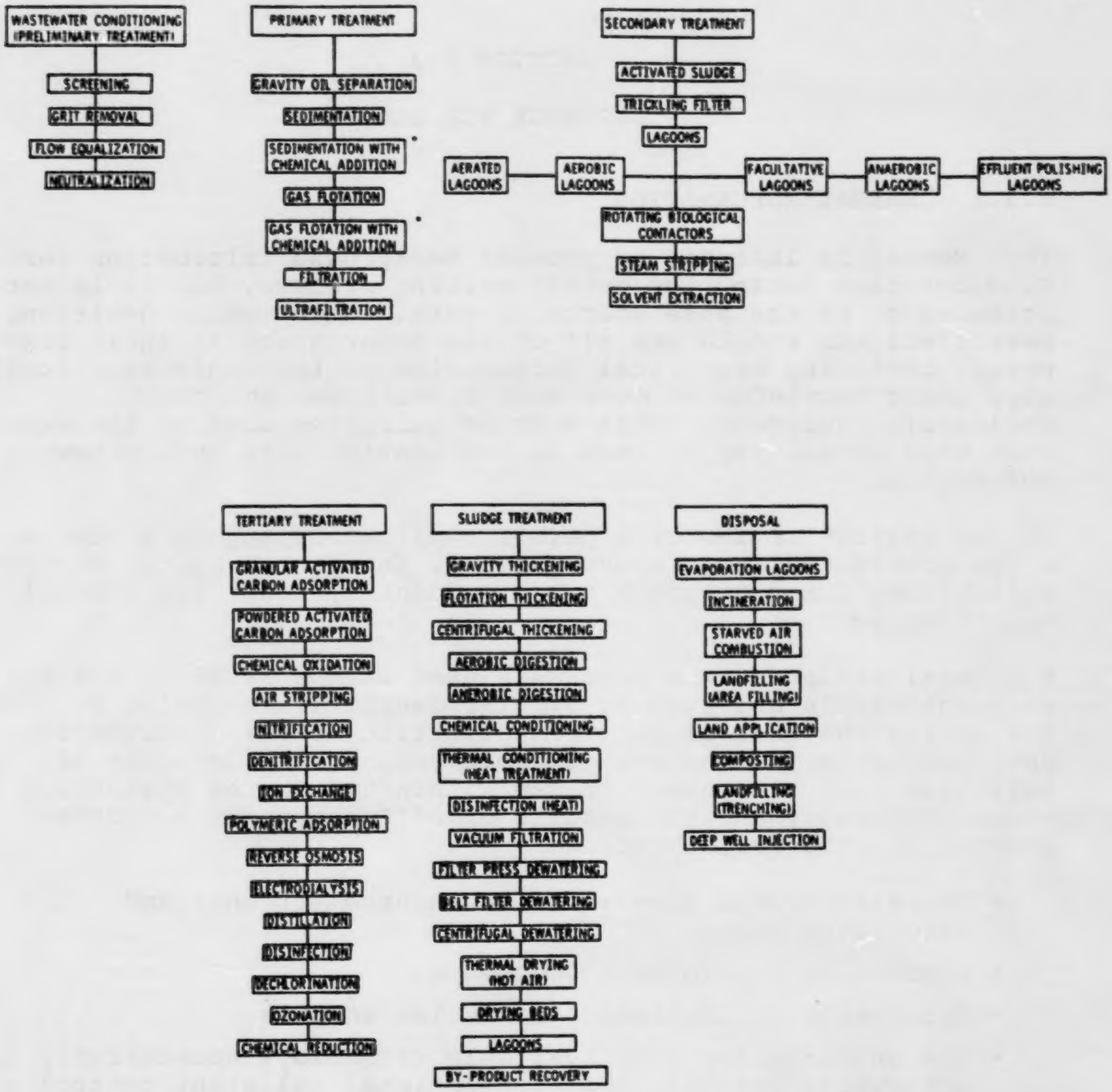
V.2.4 VOLUME IV - COST ESTIMATING

Volume IV provides information on typical costs of pollution control systems. Purchase cost, capital investment, and annual operating costs are provided separately for each technology, as a function of the plant size.

Costs, presented in dollars, generally do not include the cost of the land needed for the plant or the costs of special materials for corrosive service. Such additional expenses must be considered on a case-by-case basis. Costs for the disposal of by-products from water pollution control (air pollution emissions, solid sludge disposal, etc.) also are not included.

Costs are included for the following:

- Engineering and design;
- Equipment purchase and installation;
- Total capital cost;
- Total direct operating cost, including materials, chemicals, power, fuel and labor; and
- Total annual operating cost, including total direct operating cost and total indirect operating cost (plant overhead, taxes, insurance, administrative expenses, depreciation, and interest on working capital).


WASTEWATER CONDITIONING (PRELIMINARY TREATMENT)
SCREENING
GRIT REMOVAL
FLOW EQUALIZATION
NEUTRALIZATION
PRIMARY TREATMENT
GRAVITY OIL SEPARATION
SEDIMENTATION
SEDIMENTATION WITH CHEMICAL ADDITION •
GAS FLOTATION
GAS FLOTATION WITH CHEMICAL ADDITION •
FILTRATION
ULTRAFILTRATION
SECONDARY TREATMENT
ACTIVATED SLUDGE
TRICKLING FILTER
LAGOONS
AERATED LAGOONS
AEROBIC LAGOONS
FACULTATIVE LAGOONS
ANAEROBIC LAGOONS
EFFLUENT POLISHING LAGOONS
ROTATING BIOLOGICAL CONTACTORS
STEAM STRIPPING
SOLVENT EXTRACTION
TERTIARY TREATMENT
GRANULAR ACTIVATED CARBON ADSORPTION
POWDERED ACTIVATED CARBON ADSORPTION
CHEMICAL OXIDATION
AIR STRIPPING
NITRIFICATION
DENITRIFICATION
ION EXCHANGE
POLYMERIC ADSORPTION
REVERSE OSMOSIS
ELECTRODIALYSIS
DISTILLATION
DISINFECTION
DECHLORINATION
OZONATION
CHEMICAL REDUCTION
SLUDGE TREATMENT
GRAVITY THICKENING
FLOTATION THICKENING
CENTRIFUGAL THICKENING
AEROBIC DIGESTION
ANAEROBIC DIGESTION
CHEMICAL CONDITIONING
THERMAL CONDITIONING (HEAT TREATMENT)
DISINFECTION (HEAT)
VACUUM FILTRATION
FILTER PRESS DEWATERING
BELT FILTER DEWATERING
CENTRIFUGAL DEWATERING
THERMAL DRYING (HOT AIR)
DRYING BEDS
LAGOONS
BY-PRODUCT RECOVERY
DISPOSAL
EVAPORATION LAGOONS
INCINERATION
STARVED AIR COMBUSTION
LANDFILLING (AREA FILLING)
LAND APPLICATION
COMPOSTING
LANDFILLING (TRENCHING)
DEEP WELL INJECTION

• SUBCLASSIFICATIONS FOR PERFORMANCE DATA SUMMARY PURPOSES ARE BASED ON THE TYPES OF COAGULANTS OR SETTLING AIDS USED.

Figure V.1. Treatment technology overview.

SECTION V.3

GUIDANCE FOR USE

V.3.1 GENERAL INFORMATION

This Manual is intended to provide background information for consideration during the permit-writing process, but it is not intended to be the sole source of data. When making decisions, permit writers should use all of the information at their disposal, including historical information on the individual facility, their knowledge of many such facilities, and their engineering judgment. This section indicates some of the ways that this Manual may be used in combination with such other information.

If the initial review of a permit application suggests that only a few problem pollutants are present, the permit writer may consult Volume I and Volume V to help identify candidate control technologies.

A general review of the processes used at the facility and the effluent levels observed at similar facilities may also be useful during the initial permit application review. Volume II describes selected industrial processes, the major types of pollution control systems in use within the United States for these processes, and the results of effluent testing. Other sources of information include:

- The first-round permit for the source (if any) and associated files;
- Applicable Development Documents;
- Attainable limitations for similar sources;
- EPA guidance for best available technology economically achievable (BATEA), best conventional pollutant control technology (BCT), best practical control technology currently available (BPTCA), and best management practices (BMP);
- Visits to the site or to similar installations;
- Results of ambient and effluent water monitoring; and
- Additional information supplied by the permit applicant.

In the absence of applicable BATEA guidelines or new source performance standards covering the industrial subcategory, the permit writer may issue a "short-term" permit for a previously permitted facility which is effective for only 18 months past the date of promulgation of BATEA guidelines. (The "Second-Round Permits Policy" guidance dated July 20, 1978 [3] should be consulted for details.)

Where a "short-term" permit is about to expire and BATEA guidelines, Standards of Performance for New Sources (NSPS), or Pretreatment Standards for Existing Sources (PSES) are still not promulgated, the permit writer may be called upon to determine appropriate limits for toxic pollutants or nonconventional pollutants on a case-by-case basis. This Manual is intended to be a systematized source of all data presently available so that the permit writer will not have to do a complete literature search himself while considering each case-by-case or best engineering judgment (BEJ) permit. The permit writer still may have to review literature published after the time interval covered by this Manual, but this should be a much smaller task.

Hundreds of combinations of control technologies may be possible for discharges that cannot be recycled or reused from a complex facility. Although the treatment processes already installed at a plant may reduce the number of plausible combinations, a "process of elimination" to reduce the number of systems given detailed consideration may be desirable. Volume II can be consulted to determine which of the pollution control systems on similar or related processes have been demonstrated to give the desired concentrations or control efficiencies, and which systems have shown inadequate performance.

For each industrial process studied, Volume II contains tables showing the control technologies in use on full-scale installations within the United States, whether or not quantitative effluent data are available. To supplement those tables, Appendix A in this volume shows those combinations of industrial processes and control technologies for which quantitative effluent data are available. There are four columns per combination:

- The first column shows the number of data sets containing influent and effluent data for full-scale commercial plants.
- The second column shows the number of data sets containing influent and effluent data for pilot plants.
- The third column shows the number of data sets containing influent and effluent data for bench-scale plants.

- The fourth column shows the number of data sets for plants of any kind for which only effluent concentrations data were available. Control efficiency data are not included because no data were available on influents into the control system.

For example, there is one data set containing both influent and effluent data for a pilot-scale reverse osmosis system in the timber products processing industry.

The information in Volume III on the applicability and reliability of different control technologies may also be useful for narrowing the range of potentially applicable pollution control systems. Appendix B summarizes the median observed effluent concentrations for primary, secondary, and tertiary control technologies, respectively. Median removal efficiencies for each control technology are shown in Appendix C. The pollutants are listed in same order as they appear in Form 2c-NPDES from the Draft Consolidated Permit Application Form (44 FR 34346, June 14, 1979) [3].

Users should be cautious about applying these values to specific installations without supplementary information because the quality of treated effluents may vary for different industrial processes. It is also important to note that data were not reported for all pollutants in all effluent tests. Therefore, the set of individual plant test results processed to determine median performance for one pollutant is usually not the same as that for a different pollutants. The number of data points used to generate the medians for an individual pollutant may be determined from the summary tables in Volume III or Appendix D of this volume. A pollution control system with the tabulated median performance for one pollutant may or may not deliver the tabulated median performance for another pollutant. The individual data sheets in Volume III should be consulted to determine how well a system has been demonstrated to perform for several pollutants at once.

Appendix D, the Pollutant Treatability Index, provides a summary of the highest observed removal efficiency and the lowest observed effluent concentration for various pollutants (when a measurable influent concentration exists) as a function of the technology used to control the discharge. Cross references to Volume III are also provided. Details given in the references should indicate whether the tests summarized were performed on effluents similar to the effluent being studied.

The possibility of a novel combination of control equipment constituting the most effective pollution control technology for an industrial process cannot be eliminated *a priori*. If a novel combination of control technologies appears necessary for adequate control of an effluent, pilot-scale tests of effluent treatability should be considered, even though some insights might be gained from consulting Volume III for the individual treatment processes.

Volume IV provides information on the capital costs, purchase and installation costs, and annual operating cost of various control technologies. The accuracy of these cost figures is not expected to be better than ±30%. If the effluent characteristics or treatment technology design or operating parameters deviate widely from those stated, costs may be quite different. The cost of land, special equipment for corrosive service, and control of air pollution and pollution from solid waste disposal are not included.

V.3.2 STEPWISE APPROACH FOR USING THIS MANUAL

The steps listed below may be followed in using the Manual and the information in revised permit applications to write §402(a)(1) second-round permits. This sequence is intended only as an example because many circumstances may arise during the preparation of a given permit which justify the deletion of certain steps or the addition of others.

Step 1. Complete preapplication communications or hold conferences with permittee.

Step 2. Review first-round permit to determine the parameters limited and BPT levels.

Step 3. Review the permittee's compliance with first-round permit to detect obvious deficiencies.

Step 4. Conduct a preliminary review of the application for completeness and obvious inconsistencies. Notify the prospective permittee immediately if further information or clarification is needed.

Step 5. Consult Volume II of this Manual and the applicable Development Document for a description of the industry, its wastes, and treatment technology.

Step 6. Identify any applicable promulgated effluent guidelines, pretreatment standards, or water quality standards as of the current date.

Step 7. Review wastewater pollutants reported in the application to determine:

   a. which toxic pollutants are present and whether there are groups of toxic pollutants (chemical classes or treatability classes); and

   b. traditional parameters present.

Step 8. Consider BMP approaches to toxic pollutant reduction on particular processes, if appropriate.

Step 9. Consider requests for exclusion of specific hazardous substances from Section 311 coverage and review Volumes I and III for applicable treatment.

Step 10. Refer to this volume (Section V.4) to determine the potential "indicator" pollutant parameters for the toxic pollutants found. Where possible, determine the optimum overlap in coverage of a number of toxic pollutants by as few indicators as possible.

Step 11. Refer to Volume III to determine the treatment technology options capable of assuring adequate toxics reduction or reducing indicator parameters to levels that reasonably assure adequate toxic pollutant reduction. Review of Volume II should provide indications of "significant" parameters from the Effluent Guidelines Division (EGD) perspective in planning BAT. If resource or time constraints require a choice among controlled parameters, the permit writer may choose to focus on coverage of those.

Step 12. If the production volume has changed or the facility been modified, recalculate BPT (including BCT, Water Quality Standards (WQS), and 402(a)(1) considerations).

Step 13. Summarizing, choose the most suitable treatment processes, taking into consideration:

a. Attainment of desired toxic pollutant level;
b. Ability to monitor the operation of the system using indicator substances or other operating parameters;
c. Process reliability and operator skill requirements;
d. Recovery of products;
e. Reuse and recycling of water;
f. Overall process simplicity;
g. Process options consistent with or in addition to those already in place;
h. Prospect of meeting future limits based on BAT guidelines;
i. Cost (in a general way) including:
    (1) a comparison of processes capable of achieving acceptable controls; and
    (2) cost/benefit on levels of reduction below minimum acceptable reduction.

Step 14. Refer to Volume III and this volume for levels of toxic pollutants or "indicator" parameters that are attainable by the installation of the specific combination of treatment processes chosen, if they are properly designed, sized, operated, and maintained.

Step 15. Calculate the interim and final permit limits.

Step 16. Determine any special requirements, e.g., pilot-plant treatability studies or additional monitoring.

Step 17. Determine a compliance schedule leading to BAT by 7/1/84, where appropriate.

Step 18. Complete a "fact sheet" summarizing the considerations that served as a basis for writing the permit, including a listing of "indicator" pollutants limited and toxic pollutants "covered" by each (as noted in column 3, p. 34398 of 44 Federal Register, June 14, 1979) [2].

Step 19. Complete the draft permit and issue a public notice.

SECTION V.4

INDICATORS

On May 19, 1980, the EPA published consolidated permit regulations (45 Federal Register, May 19, 1980, pp. 33290 to 33588). These involved, among other concepts, the use of limits on "indicator" pollutants to control toxic pollutants and hazardous substances [4]. Excerpts from Section 125.3 of the regulations are quoted below.

> (Excerpt from 45 Federal Register 33512, May 19, 1980) [4]
>
> (g)(1) The Director may set a permit limit for a conventional pollutant at a level more stringent than the best conventional pollution control technology (BCT), or a limit for a nonconventional pollutant which shall not be subject to modification under section 301 (c) or (g) of the Act where:
> (i) Effluent limitations guidelines specify the pollutant as an indicator for a toxic pollutant, or
> (ii)(A) The limitation reflects BAT-level control of discharges of one or more toxic pollutants which are present in the waste stream, and a specific BAT limitation upon the toxic pollutant(s) is not feasible for economic or technical reasons;
> (B) The permit identifies which toxic pollutants are intended to be controlled by use of the limitation; and
> (C) The fact sheet required by § 124.56 sets forth the basis for the limitation, including a finding that compliance with the limitation will result in BAT-level control of the toxic pollutant discharges identified in paragraph (g)(1)(ii)(B) of this section, and a finding that it would be economically or technically infeasible to directly limit the toxic pollutant(s).
> (2) The Director may set a permit limit for a conventional pollutant at a level more stringent than BCT when:
> (i) Effluent limitations guidelines specify the pollutant as an indicator for a hazardous substance, or
> (ii)(A) The limitation reflects BAT-level control of discharges (or an appropriate level determined under section 301(c) or (g) of the Act) of one or more hazardous substance(s) which are present in the waste stream, and a specific BAT (or other appropriate) limitation upon the hazardous substance(s) is not feasible for economic or technical reasons;

(B) The permit identifies which hazardous substances are intended to be controlled by use of the limitation; and

(C) The fact sheet required by § 124.56 sets forth the basis for the limitation, including a finding that compliance with the limitations will result in BAT-level (or other appropriate level) control of the hazardous substances discharges identified in paragraph (g)(2)(ii)(B) of this section, and a finding that it would be economically or technically infeasible to directly limit the hazardous substance(s).

(iii) Hazardous substances which are also toxic pollutants are subject to paragraph (g)(1) of this section.

(3) The Director may not set a more stringent limit under the preceding paragraphs if the method of treatment required to comply with the limit differs from that which would be required if the toxic pollutant(s) or hazardous substance(s) controlled by the limit were limited directly.

(4) Toxic pollutants identified under paragraph (g)(1) of this section remain subject to the requirements of § 122.61(a)(1) (notification of increased discharges of toxic pollutants above levels reported in the application form).

In addition, the May 19, 1980 Federal Register contains a detailed discussion of the use of indicators and the associated regulations. It is quoted below. While the discussion focuses on the control of toxic pollutants, most of it pertains to hazardous substances as well.

(Excerpt from 45 Federal Register 33524 to 33526, May 19, 1980) [4]

a. *Outline of Strategy.* EPA generally will use the word "indicator" to refer to conventional and nonconventional pollutants used as authorized in § 125.3(g). Several commenters pointed out the BAT limits on toxic pollutants, BCT limits on conventional pollutants and modified (e.g., to BPT levels) limits on nonconventional pollutants may, in appropriate circumstances, be used as "indicator" pollutants. EPA agrees. However, the use of such pollutants as indicators does not require any new regulations.

As described above in section III.B.1 of this preamble, permit writers must set technology-based limits to control pollutants by applying guidelines or, in the absence of applicable guidelines, by setting case-by-case limits under section 402(a)(1) of CWA. In some cases, it is not feasible to set limits on each discharged pollutant. This is particularly true in the case of organic pollutants, because they can be expensive to sample and analyze and because there is relatively limited experience and historical data demonstrating achievable levels of removals by various types of technology.

EPA believes that the most appropriate way to regulate toxic pollutants is to limit toxic pollutants. As discussed in section III.B.1 of this preamble, EPA has prepared a five-volume treatability manual, compiling data on treatability levels of specific toxic pollutants which have been achieved by particular technologies, to help permit writers to limit toxic pollutants directly when guidelines do not apply.

However, as noted above, direct limitation of all toxic pollutants in a waste stream is not always feasible. In such cases, limiting indicator pollutants (or selected toxic pollutants) is sometimes an appropriate alternative. When a certain treatment system is the most cost-effective method for limiting toxic pollutants, and where limits on certain other pollutants (e.g., BOD, COD, chromium and total phenols) found in the discharge would require installation of the treatment system, then those other pollutants are referred to as "indicator" pollutants.

The term "indicator" is not intended to denote a statistical relationship between the limited pollutants and the non-limited toxic pollutants. It means simply that the limits on the indicators will reflect (i.e., result in installation of) the best available technology economically achievable to reduce discharges of the toxic pollutants. Note that the identification of BAT technology for the toxic pollutants does not require precise knowledge of the numerical levels of those pollutants to be achieved by installation of that technology. Of course, to be defensible as BAT, the general effectiveness of the technology as compared to alternative technologies must be known. Such qualitative relationships are more easily discerned and agreed-upon, based on existing treatability data, than the actual numbers which may be achieved to a desired confidence interval by the compared technologies.

An approach similar to the indicator approach was used frequently in developing existing BPT guidelines, although the term "indicator" was not used. Such guidelines include various mining (coal, ore, mineral) and metals industries. A typical example is the use of limits on pH, TSS, and one or two metals to assure the precipitation not only of the limited metals, but of others as well.

If a pollutant is used as an indicator for toxic pollutants, its limit must reflect BAT for those toxic pollutants. This is clearly required by section 301(b) of CWA, which states that limits to control toxic pollutants must reflect BAT. Therefore, § 125.3(g) provides that, for conventional pollutants listed under section 304(a)(4) of CWA which are used as indicators for toxic pollutants, the Director may set limits at levels which are more stringent than the best conventional pollutant control technology (BCT). Similarly, for nonconventional pollutants (those not listed as either conventional or toxic pollutants) which are used as indicators for toxic pollutants, the Director may set limits which are not subject to modification under sections 301 (c) or (g) of CWA. (As one commenter pointed out, and as directly acknowledged in § 125.3(g)(2), nonconventional pollutants used as indicators for hazardous substances not listed as toxic under section 307(a) of CWA are subject to requests for 301 (c) and (g) modifications.)

EPA stresses that the Director may invoke § 125.3(g) only after establishing that direct limitation of the toxic pollutant is not feasible for economic or technical reasons and that limitation of the indicator will result in BAT-level control of the toxic pollutant discharges. The permit applicant may challenge the use of an indicator and offer evidence to support direct limitations of toxic pollutants. EPA intends to apply the indicator strategy reasonably, with toxic limits remaining the preferred approach whenever feasible.

b. *Response to Comments.* EPA received many comments on proposed § 125.3(g). The comments almost uniformly favored the use of indicators in appropriate circumstances when agreed upon by both the permitting authority and permit applicant. Several industries strongly encouraged the use of indicators. However, most commenters expressed reservations concerning the scope of proposed § 125.3(g).

Several commenters were concerned that proposed § 125.3(g) might authorize the Director to impose indicator limits which would require the discharger to control discharges of toxic pollutants in a cost-ineffective manner by requiring too stringent control of the indicator. For example, segregation of toxic waste streams, process changes and raw materials substitutions are possible means of controlling particular toxic pollutant discharges without controlling any parameter intended to serve as an indicator.

EPA agrees that limits on indicators should not be used to require greater or more expensive effluent control than would be required if all pollutants were regulated directly. § 125.3(g) has therefore been amended by the addition of a requirement that the Director may not impose a more stringent limit on a pollutant intended to be used as an indicator when the limit would effectively require the permittee to use a method of treatment which differs from that which would be required if the toxic pollutants were limited directly. In the event that the Director uses an indicator limit in the draft or final permit that the discharger believes would preclude the use of more cost-effective measures to regulate the indicated toxic pollutants, the discharger can make appropriate objections challenging the limits under the procedures in 40 CFR Part 124.

Several commenters requested that the concurrence of the permittee be obtained before an indicator limit is set in the permit. Another requested simply that the permittee be given an opportunity to comment on the proposed use of indicator limits. EPA believes that it is administratively infeasible to obtain the permittee's concurrence in each situation before setting indicator limits. However, the procedures in 40 CFR Part 124, which include opportunities for permittees to comment on the draft permit, request an evidentiary hearing after the permit is issued (unless an expanded non-adversary hearing has been held during the comment period under Part 124, Subpart F) and appeal to the Administrator, will afford significant opportunity for permit writers and permittees to resolve disagreements. The strict restrictions placed by § 125.3(g) upon the use of indicators, together with the possibility of administrative and judicial review, will insure that permit writers do not use indicators improperly.

Some commenters argued that the limitation of conventional indicators beyond BCT and the denial of variance opportunities for nonconventional indicators is contrary to the requirements of CWA. EPA disagrees. When limits on indicators are used as a means to control toxic pollutants, they must reflect the best available technology economically achievable (BAT) to control the toxic pollutants. As long as the requirements of § 125.3(g) are met (i.e., that indicators be used only where direct limitation of toxic pollutants is infeasible and that indicators not be used to require control technology which is not needed to control the toxic pollutants), discharges will effectively be subject to precisely those technology-based requirements required by section 301 of CWA.

Many commenters expressed concern over the possible lack of correlation between levels of indicators and the controlled toxic pollutants. The commenters noted that certain indicators may be present in concentrations several orders of magnitude greater than the toxic pollutant. This comment was most imaginatively expressed by the Chemical Manufacturers Association, which stated: "To select an 'indicator' controlled to concentrations several orders of magnitude greater than the toxics indicated is almost like trying to determine the weight of a flea by weighing a dog with and without the flea." Still other commenters attempted to support their objections by submitting charts demonstrating the poor correlation between what they termed an indicator and a specific pollutant (e.g., total suspended solids and zinc) in their discharges.

EPA believes that the above commenters have misconstrued the "indicator" concept and regulation. EPA does not assert that indicators and specific toxic pollutants controlled through the indicator limits must be or are likely to be statistically correlated. Nor does it assert that any pollutant used as a measure of a class of compounds will necessarily be statistically correlated to each or any compound in that class. Rather, the function of an indicator limit is to assure the installation and maintenance of BAT controls for toxic pollutants. Sufficiently low limits on one or more indicators may require installation of treatment equipment known to constitute BAT for certain toxic pollutants. In that case (and only in that case), the indicator limits will have served their purpose of assuring BAT control of the toxic pollutants, whether or not a correlation exists between the indicators and toxics.

Two commenters urged the use of bioassays instead of indicators or to calibrate indicators. The use of bioassays is discussed below in sections III.D.2.d and III.E.2 of this preamble. It is noted here, however, that bioassays and indicators generally serve different purposes and are not generally substitutable for each other.

Some industrial commenters argued that if the indicator concentrations are not statistically correlated with the toxic concentrations, a violation of an indicator limit may occur even when the indicated toxics are not being discharged at significant levels. EPA does not expect this to be a problem. Indicators will be used only where necessary to control discharges of toxic pollutants. If a toxic pollutant will not be discharged at levels above those achievable by BAT, then an indicator limit will not be authorized by § 122.3(g).

If an indicator limit is violated by the permittee, this demonstrates improper operation or maintenance by the permittee of its treatment system. In such a situation, the violation may properly result in an enforcement action. Of course, a situation may arise where indicator limits are set to control toxic pollutants which are discharged above BAT levels at the time of permit application, but which are later no longer present at levels requiring control.

In that case, the permittee may apply for a permit modification to eliminate the indicator limit or to modify it to a less stringent level authorized by law.

Some environmental groups used similar logic to that used in the preceding comment by industrial commenters and argued that if indicator concentrations are not correlated with toxic pollutant concentrations, a significant discharge of toxic pollutants may not result in a violation of the indicator limit. EPA agrees, as it acknowledged in the June 14 preamble, that this is a possibility in some cases. However, the proper selection of indicators should assure that violation of the indicator limits will occur whenever the treatment system is not properly operated or maintained. When the system is properly operated or maintained, the indicated toxics should generally be reduced to levels below BAT. Furthermore, as noted above, the regulations allow the use of indicators only where the direct limitation of toxic pollutants is infeasible.

EPA also notes that occasional monitoring of specific toxic pollutants as required by the permitting authority would reveal whether an indicated toxic is being discharged at high levels. If so, the application-based notification requirements of § 122.61(a) would be triggered. The permitting authority could then, if necessary and feasible, modify the permit to limit the toxic directly. EPA has rejected the suggestion by one environmental commenter that EPA specify technology in conjunction with the use of indicators. Such an approach is inconsistent with the general statutory approach that, except for the specification of best management practices in certain instances (see § 122.62(k)), permits should specify effluent limitations rather than technologies or control practices.

Some commenters suggested that indicators be used only for monitoring purposes. EPA disagrees. Although direct limitation of toxic pollutants is required whenever feasible, indicators may be necessary as permit limits in certain situations. However, indicators may be used for frequent monitoring purposes when toxics are limited directly. In such situations, the indicators would be monitored frequently, and the toxics would be monitored less frequently to reduce monitoring costs.

Some environmental commenters suggested that any violation of an indicator limit should trigger automatic monitoring of the indicated toxics, as was suggested in the preamble. Such monitoring will often be appropriate when indicator limits are violated. However, in many instances, the source of the violation may be discerned and corrected without such testing. Therefore, EPA has rejected this suggestion. The Director thus retains the flexibility to take the most appropriate approach to discover and remedy the cause of the violation. In addition, the final consolidated regulations (in § 122.62(g)) require permits to specify that violations of maximum daily discharge limitations on indicators, as well as limitations on toxic pollutants and hazardous substances, must be reported within 24 hours, so that the Director may take appropriate action.

One commenter noted that the statutory deadlines for an indicator and the indicated pollutants may differ in certain cases under section 301(b) of the Clean Water Act. When a parameter is used as an indicator, any earlier statutory deadline for the indicated pollutant controls.

Finally, some commenters argued that application-based limits (proposed § 122.66(a)) should not apply to indicated toxic pollutants. As explained in section III.B.1 of this preamble, EPA has deleted its proposed application-based limits from the final regulations. Thus, under the final rule, indicated toxics will not be subject to application-based limits. They will, however, be subject to the much less burdensome application-based notification requirements in § 122.61(a).

SECTION V.5

REFERENCES

1. The Clean Water Act, Showing Changes Made by the 1977 Amendments. U.S. Government Printing Office, Washington, DC, 1977.

2. Environmental Protection Agency; Proposed Consolidated Permits Regulations, Draft Consolidated Permit Application Forms and Proposed National Pollutant Discharge Eliminatio System Regulations. Federal Register, 44(16):34346-34416, 1979.

3. Environmental Protection Agency, Second Round Permits Policy, July 20, 1978.

4. Environmental Protection Agency, Consolidated Permit Program. Federal Register, 45(98):33287-33588, 1980.

SECTION V.6

BIBLIOGRAPHY

A. REFERENCES USED IN VOLUMES I-IV

References Used in Volume I

The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967.

CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977.

Dobbs, R.A., and J.M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April 1980.

Dobbs, R. A., R. J. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Fairchild, E. J., R. J. Lewis, Sr., and R. L. Taken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977.

Ferguson, T.L., Bergman, F.S., Cooper, G.R., Li, R.T., and F.I. Honea. Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio, July 1975

Fochtman, E. G., and W. Eisenberg. Treatability of Carcinogenic and Other Hazardous Organic Compounds. Illinois Institute of Technology Research Institute, Chicago, Illinois. 58 pp.

Initial Scientific and Minieconomic Review of Methyl Parathion, Criteria and Evaluation Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C., 1971.

Interscience Encyclopedia, Inc. Encyclopedia of Chemical Technology, Volume 5, 3rd Edition. New York, New York, 1978.

Jordan, T. E. Vapor Pressure of Organic Compounds. Interscience Publishers, Inc., New York, New York, 1954.

McGraw Hill, Inc. Lange's Handbook of Chemistry, 12th Edition. New York, New York, 1979.

Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976.

Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

The National Research Council of the U.S.A. International Critical Tables of Numerical Data, Physics, Chemistry, and Technology, Volume III. McGraw-Hill, New York, New York, 1928.

Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979.

Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:1-5, 1976.

Quellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977.

Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Tabak, H. H., and E. F. Barth. Biodegradability of Benzidine in Aerobic Suspended Growth Reactors. Journal of the Water Pollution Control Federation, March 1978. 7 pp.

Tucker, E. S., V. W. Saeger, and O. Hicks. Activated Sludge Primary Biodegradation of Polychlorinated Biphenyls. Monsanto Company, St. Louis, Missouri, March 1975. 9 pp.

Versar, Inc. Water Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Waghington, D.C., 1979.

Versar, Inc. Water Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979.

Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977.

Warner, H.P., Cohen, J.M., and J.C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants, Cincinnati, Ohio, April 1980. 14pp.

References Used in Volume II

Auto and Other Laundries --

NRDC Consent Decree Industry Summary - Auto and Other Laundries.

Status Report on the Treatment and Recycle of Wastewaters from the Car Wash Industry (draft contractor's report). Contract 68-01-5667, U.S. Environmental Protection Agency, Washington, DC, July 1979.

Technical Support Document for Auto and Other Laundries Industry (draft contractor's report). Contract 68-03-2550, U.S. Environmental Protection Agency, Washington, D.C., August 1979.

Coal Mining --

Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Coal Mining Point Source Category. EPA 440/1-75/057 Group II, U.S. Environmental Protection Agency, Washington, D.C., October 1975.

NRDC Consent Decree Industry Summary - Coal Mining.

Technical Assistance in the Implementation of the BAT Review of Coal Mining Industry Point Source Category (draft contractor's report). Contracts 68-01-3273, 68-01-4762, and 68-02-2618, U.S. Environmental Protection Agency, Washington, D.C., March 1979.

Electroplating --

Environmental Protection Agency Effluent Guidelines and Standards for Electroplating. Environment Reporter, 135:0341-0351, as of 5 May 1980.

Final Development Document for Existing Source Pretreatment Standards for the Electroplating Point Source Category. EPA 440/1-79/003, U.S. Environmental Protection Agency, Washington, D.C., August 1979. 526 pp.

NRDC Consent Decree Industry Summary - Electroplating.

Inorganic Chemicals Manufacturing --

Development Document for Effluent Limitations Guidelines and NSPS for the Major Inorganic Products Point Source Category. EPA-440/1-74-007-a, U.S. Environmental Protection Agency, Washington, D.C., March 1974.

Draft Development Document for Inorganic Chemicals Manufacturing Point Source Category - BATEA, NSPS, and Pretreatment Standards (draft contractor's report). Contract 68-01-4492, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C., April 1979.

Environmental Protection Agency Effluent Guidelines and Standards for Inorganic Chemicals (40CFR415; 39FR9612, March 12, 1974; amended as shown in Code of Federal Regulations, Vol. 40, revised as of July 1, 1976; 41FR51599 and 51601, November 23, 1976; 42FR17443, April 1, 1977, 42FR10681, February 23, 1977; 42FR37294, July 20, 1977).

NRDC Consent Decree Industry Summary - Inorganic Chemicals Industry.

Supplement for Pretreatment to the Development Document for the Inorganic Chemicals Manufacturing Point Source Category. EPA-400/1-77/087A, U.S. Environmental Protection Agency, Washington, D.C., July 1977.

Iron and Steel Manufacturing --

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume I - General. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume II - By-Product Cokemaking and Beehive Cokemaking Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume III - Sintering and Blast Furnace Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume IV - Basic Oxygen Furnace and Open Hearth Furnace Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category, Volume V - Electric Arc Furnace, Vacuum Degassing, and Continuous Casting Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category Volume VI.- Hot Forming-Primary, Hot Forming Section, Hot-Forming-Flat, and Hot Forming-Pipe and Tube Subcategories, U.S. Environmental Protection Agency, Washington, D.C., October 1979.

Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category-Volume VII - Pipe and Tube, and Cold Rolling Subcategories. U.S. Environmental Protection Agency, Washington, D.C. October 1979.

Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category - Volume VIII - Sulfuric Acid Pickling, Hydrochloric Acid Pickling, and Combination Acid Pickling Subcategories. U.S. Environmental Protection Agency, Washington, D.C., October, 1979.

Draft Development Document for Proposed Effluent Limitation and Standards for the Iron and Steel Manufacturing Point Source Category - Volume IX - Hot Coatings, Scale Removal, and Alkaline Cleaning Subcategories. U.S. Environmental Protection Agency, Washington, D.C., October, 1979.

NRDC Consent Decree Industry Summary - Iron and Steel Industry.

Environmental Protection Agency, Effluent Guidelines and Standards for Iron and Steel Manufacturing (40CFR420; 39FR24114, June 28, 1974; Amended by 41 FR 13004, March 29, 1976; 41 FR 32218, August 2, 1976).

Leather Tanning and Finishing Industry --

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Leather Tanning and Finishing Point Source Category. U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C., July 1979.

Effluent Guidelines and Standards for Leather Tanning and Finishing. U.S. Environmental Protection Agency, 40 CFR 425; 39 FR 12958, April 9, 1974.

NRDC Consent Decree Industry Summary. Leather Tanning and Finishing Industry.

Coil Coating --

Development Document for Effluent Limitations Guidelines and Standards for the Coil Coating paint Source Category. EPA 440/1-79/071a, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D,C., August 1979.

NRDC Consent Decree Industry Summary - Coil Coating Industry.

Foundries --

Foundry Industry (Contractor's Draft Report). Contract 68-01-4379, U.S. Environmental Protection Agency, Washington, D.C., May 1979.

NRDC Consent Decree Industry Summary - Foundries.

Porcelain Enameling --

Development Document for Effluent Limitations Guidelines and Standards for the Porcelain Enameling Point Source Category. EPA-440/1-79/072a, U.S. Environmental Protection Agency, Washington, D.C., August 1975.

NRDC Consent Decree Industry Summary - Porcelain Enameling Industry.

Explosives Manufacture --

Environmental Protection Agency Effluent Guidelines and Standards for Explosives Manufacturing. 40 CRF 457; 41 FR 10180, March 9, 1976.

NRDC Consent Decree Industry Summary - Explosive Manufacturing.

Technical Review of the BAT Analysis of the Explosives Industry (draft contractor's report). U.S. Environmental Protection Agency, Washington, D.C., April 1979.

Gum and Wood Chemicals --

NRDC Consent Decree Industry Summary - Gum and Wood Chemicals Industry

Technical Review of the Best Available Technology, Best Demonstrated Technology, and Pretreatment Technology for the Gum and Wood Chemicals Point Source Category (draft contractor's report) Environmental Science and Engineering, Inc.

Pharmaceutical Manufacturing --

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Pharmaceutical Manufacturing Point Source Category. EPA 400/ 1-75/060. U.S. Environmental Protection Agency, Washington, D.C., December 1976. 344 pp.

Effluent Limitations Guidelines for the Pharmaceutical Manufacturing Industry (draft contractor's report). U.S. Environmental Protection Agency, Washington, D.C., May 1979.

Environmental Protection Agency Effluent Guidelines and Standards for Pharmaceutical Manufacturing. 40 CFR 439; 41 FR 50676, November 17, 1976; Amended by 42 FR 6813, February, 1977.

Supplement to the Draft Contractor's Engineering Report for the Development of Effluent Limitations Guidelines for the Pharmaceutical Industry (BATEA, NSPS, BCT, BMP, Pretreatment). U.S. Environmental Protection Agency, Washington, D.C., July 1979.

Nonferrous Metals Manufacturing --

Draft Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category, Effluent Guidelines Division, Office of Water and Waste management, U.S. Environmental Protection Agency, September 1979.

Environmental Protection Agency - Effluent Guidelines and Standards for Nonferrous Metals. 40 CRF 421; 39 FR 12822, April 8, 1974; Amended by 40 FR 8514, February 27, 1975; 40 FR 48348, October 15, 1975; 41 FR 54850, December 15, 1976.

NRDC Consent Decree Industry Summary - Nonferrous Metals Manufacturing Industry.

Ore Mining and Dressing --

Development Document for BAT Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Industry, (draft contractor's report). Contract No. 68-01-4845, U.S. Environmental Protection Agency,Washington, D.C., 25 September 1979.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category, Volumes I and II. U.S. Environmental Protection Agency, Washington, D.C., July 1978.

Environment Reporter, EPA Effluent Guidelines and Standards for Ore Mining and Dressing (40CRF440, November 6, 1975; 41 FR 21191, May 24, 1976; 42 FR 3165, January 17, 1977, 43 FR 29771, July 11, 1978; 44 FR 7953, February 8, 1979; 44FR11546, March 1, 1979), pg. 135:0881.

NRDC Consent Decree. Industry Summary - Ore Mining and Dressing.

Paint and Ink Formulation --

Environmental Protection Agency Effluent Guidelines and Standards for Ink Formulating. 40 CFR 447; 40 FR 31723, July 28, 1975.

Environmental Protection Agency Effluent Guidelines and Standards for Paint Formulating. 40 CFR 446; 40 FR 31723, July 28, 1975.

NRDC Consent Decree Industry Summary - Paint and Ink Formulation.

Technical Study Report BATEA-NSPS-PRETREATMENT, Effluent Limitations Guidelines for the Ink Manufacturing Industry (draft contractor's report). Contract 68-01-3502, U.S. Environmental Protection Agency, Washington, D.C., January 1979.

Technical Study Report BATEA-NSPS-PRETREATMENT, Effluent Limitations Guidelines for the Paint Manufacturing Industry (draft contractor's report). Contract 68-01-3502, U.S. Environmental Protection Agency, Washington, D.C., January 1979.

Petroleum Refining --

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Petroleum Refining Point Source Category. EPA-440/1-74-014-a, U.S. Environmental Protection Agency, Washington, D.C., April 1974. 195 pp.

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Petroleum Refining Point Source Category. EPA 440/1-79/014-b, U.S. Environmental Protection Agency, Washington, D.C., December 1979.

Draft Development Document Including the Data Base for the Review of Effluent Limitations Guidelines (BATEA), New Source Performance Standards, and Pretreatment Standards for the Petroleum Refining Point Source Category. U.S. Environmental Protection Agency, Washington, D.C., March 1978.

Interim Final Supplement for Pretreatment to the Development Document for the Petroleum Refining Industry Existing Point Source Category. EPA-440/1-76/083A, U.S. Environmental Protection Agency, Washington, D.C., March 1977. 115 pp.

NRDC Consent Decree Industry Summary - Petroleum Refining.

Pulp, Paper, and Paperboard Mills --

Environmental Protection Agency Effluent Guidelines and Standards for Pulp, Paper and Paperboard (40 CFR 430; FR 18742, May 12, 1974; Amended as shown in Volume 40 Code of Federal Regulations, Revised as of July 1, 1976; 41 FR 27732, July 6, 1976; 42 FR 1398; January 6, 1977).

NRDC Consent Decree Industry Summary - Pulp, Paper, and Paperboard Industry.

Preliminary Data Base for Review of BATEA Effluent Limitations Guidelines, NSPS, and Pretreatment Standards for the Pulp, Paper, and Paperboard Point Source Category. Prepared for USEPA by E. C. Jordan Co., Inc., Portland, Maine 04112. Contract No. 68-01-4624, June 1979.

Rubber Processing --

Review of Best Available Technology for the Rubber Processing Point Source Category (draft contractor's report). Contract 68-01-4673, U.S. Environmental Protection Agency, Washington, D.C., July 1978.

Environmental Protection Agency Effluent Guidelines and Standards for Rubber Processing. 40 CFR 428; 39 FR 6660, February 21, 1974 (amended by 39 FR 26423, July 19, 1974; 40 FR 2334, January 10, 1975; 40 FR 18172, April 25, 1975 [effective May 27, 1975]; and 43 FR 6230, February 14, 1978).

NRDC Consent Decree Industry Summary - Rubber Processing.

Soaps and Detergents --

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Soap and Detergent Manufacturing Point Source Category. EPA-440/1-74-018a, U.S. Environmental Protection Agency, Washington, D.C. April 1974.

Economic Analysis of Effluent Guidelines for the Soap and Detergent Industry. EPA-230/2-73-026(PB 256 313), U.S. Environmental Protection Agency, Washington, D.C., July 1976.

Project Recommendations for the Soap and Detergent Manufacturing Industry (SIC 2841) BAT/Toxics Study. U.S. Environmental Protection Agency, Washington, D.C., November 1979.

Steam Electric Power Generating --

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steam Electric Power Generating Point Source Category. EPA-440/1-74/029-a. U.S.

Environmental Protection Agency, Washington, D.C., October 1974. 842 pp.

Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Steam Electric Power Generating Point Source Category. EPA-440/1-73/029, U.S. Environmental Protection Agency., Washington, D.C., March 1974. 677 pp.

Draft Technical Report for Recision of Steam Electric Effluent Limitations Guidelines. U.S. Environmental Protection Agency, Washington, D.C., September 1978. 607 pp.

Environmental Protection Agency Effluent Guidelines and Standards for Steam Electir Power Generating. 40 CFR 423; 39FR 36186, October 8, 1974, effective November 7, 1974; 40 FR 7095, February 19, 1975; 40 FR 23987, June 4, 1975; 42 FR 15690, March 23, 1977; 43 FR 43025, September 22, 1978; 43 FR 44848, September 29, 1978.

NRDC Consent Decree Industry Summary - Steam Electric Power Generating Industry.

Supplement for Pretreatment to the Development Document for the Steam Electric Power Generating Point Source Category. EPA-400/1-77/084, U.S. Environmental Protection Agency, Washington, D.C., April 1977. 244 pp.

Textile Mills --

MRC internal sampling data on file at Effluent Guidelines Division of EPA, 1978.

NRDC Consent Decree Industry Summary - Textile Mills.

Technical Study Report BATEA-NSPS-PSES-PSNS - Textile Mills Point Source Category (draft contractor's report). Contracts 68-01-3289 and 68-01-3884, U.S. Environmental Protection Agency, Washington, D.C., November 1978.

Timber Products Processing --

NRDC Consent Decree Industry Summary - Timber Products Processing.

Revised Technical Review of the Best Available Technology. Best Demonstrated Technology, and Pretreatment Technology for the Timber Products Processing Point Source Category (draft contractor's report). Contract 68-01-4827, U.S. Environmental Protection Agency, Washington, D.C., October 1978.

Publicly Owned Treatment Works (POTW'S) --

Fate of Priority Pollutants in Publicly Owned Treatment Works -Pilot Study. EPA-440/1-79-300, U.S. Environmental Protection Agency, Washington, D.C., October 1979.

References Used in Volume III

Argaman, Yerachmiel, and C. L. Weddle. Fate of Heavy Metals Physical Treatment Processes. In: AIChE Symposium Series, Volume 70, No. 136.

Bollyky, L. J. Ozone Treatment of CyanideBearing Plating Waste. EPA-600/2-77-104, U.S. Environmental Protection Agency, Cincinnati, Ohio, June 1977. 43 pp.

Brandon, C. A., and J. J. Porter. Hyperfiltration for Renovation of Textile Finishing Plant Wastewater. EPA-600/ 2-76-060, U.S. Environmental Protection Agency, Triangle Park, North Carolina, March 1976. 147 pp.

Brunotts, V. A., R. S. Lynch, G. R. Van Stone. Granular Carbon Handles Concentrated Waste. Chemical Engineering Progress, 6(8):81-84, 1973.

Chian, E. S. K., M. N. Aschauer, and H. H. P. Fang. Evaluation of New Reverse Osmosis Membranes for the Separation of Toxic Compounds from Wastewater. Contract No. DADA 17-73-C-3025, U.S. Army Medical Research and Development Command, Washington, D.C., October 1975. 309 pp.

CoCo, J. H., E. Klein, D. Howland, J. H. Mayes, W. A. Myers, E. Pratz, C. J. Romero, and F. H. Yocum. Development of Treatment and Control Technology for Refractory Petrochemical Wastes (draft report). Project No. S80073, U.S. Environmental Protection Agency, Ada, Oklahoma. 220 pp.

Davis, H. J., F. S. Model, and J. R. Leal. PBI Reverse Osmosis Membrane for Chromium Plating Rinse Water. EPA-600/2-78-040. U.S. Environmental Protection Agency, Cincinnati, Ohio, March 1978. 28 pp.

De, J., B. Paschal, and A. D. Adams. Treatment of Oil Refinery Wastewaters with Granular and Powdered Activated Carbon. In: Thirtieth Industrial Waste Conference, Purdue University, Indiana, May 1975. pp. 216-232.

De, J. and B. Paschal. The Effectiveness of Granular Activated Carbon in Treatability Municipal and Industrial Wastewater. In: Third National Conference on Complete Water Reuse, AIChE and EPA Technology Transfer, June 1976. pp. 204-211.

Development Document for BAT Effluent Limitations Guidelines and New Source Performance Standards for Ore Mining and Dressing Industry. No. 6332-M.1, A Division of Calspan Corporation, Buffalo, New York, 1979.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Dairy Products Processing Point Source Category. EPA-440/1-74-021a, U.S. Environmental Protection Agency, Washington, D.C., May 1974. 167 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Fish Meal, Salmon, Bottom Fish, Clam, Oyster, Sardine, Scallop, Herring, and Abalone, Segment of the Canned and Perserved Fish and Seafood Processing Industry, Point Source Category. EPA-440/1-75-041a, U.S. Environmental Protection Agency, Washington, D.C., September 1975. 485 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Leather Tanning and Finishing Point Source Category. EPA-440/1-74-016a, U.S. Environmental Protection Agency, Washington, D.C., March 1974. 157 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Plywood, Hardboard and Wood Preserving Segment of the Timber Products Processing Point Source Category. EPA-440/1-74-023a, U.S. Environmental Protection Agency, Washington, D.C., April 1974.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Synthetic Resins, Segment of the Plastics and Synthetic Materials Manufacturing Point Source Category. EPA-440/1-74-010a, U.S. Environmental Protection Agency, Washington, D.C., March 1974. 238 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Tire and Synthetic Segment of the Rubber Processing Point Source Category. EPA-440/1-74-013a, U.S. Environmental Protection Agency, Washington, D.C., February 1974. 193 pp.

Development Document for Effluent Limitations Guidelines and Standards for the Leather Tanning and Finishing Point Source Category. EPA-440/1-79-016. U.S. Environmental Protection Agency, Washington, D.C., July 1979. 381 pp.

Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. EPA-440/1-79-019a, U.S. Environmental Protection Agency, Washington, D.C., September 1979. 622 pp.

Development Document for Effluent Limitations Guidelines and Standards for the Pesticide Chemicals Manufacturing Point Source Category. EPA-440/1-78-060e, U.S. Environmental Protection Agency, Washington, D.C., April 1978. 316 pp.

Development Document for Interim Final and Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Fruits, Vegetables, and Specialties Segment of the Canned and Preserved Fruits and Vegetables Point Source Category. EPA-440/1-75-046, U.S. Environmental Protection Agency, Washington, D.C., October 1975. 520 pp.

Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Primary Copper Smelting Subcategory of the Copper Segment of the Non-ferrous Metals Manufacturing Point Source Category. EPA-440/1 1-75-032b, U.S. Environmental Protection Agency, Washington, D.C., February 1975. 213 pp.

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Gum and Wood Chemicals Manufacturing. EPA 440/1-76, U.S. Environmental Protection Agency, Washington, D.C., April 1976.

Development Document for Interim Final Effluent Limitations, Guidelines and Proposed New Source Performance Standards for the Hospital Point Source Category. EPA-440/1-76-060n, U.S. Environmental Protection Agency, Washington, D.C., April 1976. 131 pp.

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Pharmaceutical Manufacturing, Point Source Category. EPA-440/1-75-060, U.S. Environmental Protection Agency, Washington, D.C., December 1976. 331 pp.

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Raw Cane Sugar Processing Segment of the Sugar Processing Point Source Category. EPA-440/1-75-044, U.S. Environmental Protection Agency, Washington, D.C., February 1975. 291 pp.

Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Mineral Mining and Processing Industry Point Source Category. EPA-440/1-76-059a, U.S. Environmental Protection Agency, Washington, D.C., June 1976. 432 pp.

Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Major Organic Products Segment of the Organic Chemicals Manufacturing Point Source Category. EPA-440/1-73-009, U.S. Environmental Protection Agency, Washington, D.C., December 1973. 369 pp.

Development Document for Proposed Existing Source Pretreatment Standards for the Electroplating, Point Source Category. EPA-440/1-78-085, U.S. Environmental Protection Agency, Washington, D.C., February 1978. 532 pp.

Draft Contractor's Engineering Report for Development of Effluent Limitations Guidelines for the Pharmaceutical Manufacturing Industry (BATEA, NSPS, BCT, BMP, Pretreatment), July 1979, U.S. Environmental Protection Agency, Washington, D.C.

Draft Development Document for Inorganic Chemicals Manufacturing Point Source Category - BATEA, NSPS, and Pretreatment Standards (contractor's draft report). Contract 68-01-4492, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C., April 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacutring Point Source Category, Volume I. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 220 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume II. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 272 pp.

Draft Development Document for Proposed Effluent Limitation Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume III. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 308 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume IV. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 446 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume V. EPA-440/1-79/024a, U.S. Environmental Protection AGency, Washington, D.C., October 1979. 435 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume VI. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 389 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume VII. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 419 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume VIII. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 768 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume IX. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 758 pp.

Draft Technical Report for Revision of Steam Electric Effluent Limitations Guidelines, September 1978, U.S. Environmental Protection Agency, Washington, D.C.

Effects of Liquid Detergent Plant Effluent on the Rotating Biological Contactor. EPA-600/2-78-129, U.S. Environmental Protection Agency, Cincinnati, Ohio, June 1978. 58 pp.

Effluent Limitations Guidelines (BATEA), New Source Performance Standards and Pretreatment Standards for the Petroleum Refining Point Source Category, March 1978, U.S. Environmental Protection Agency, Washington, D.C.

Effluent Limitations Guidelines for the Ink Manufacturing Industry (BATEA, NSPS, Pretreatment), January 1979, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C.

Effluent Limitations Guidelines for the Paint Manufacturing Industry, January 1979, U.S. Environmental Protection Agency, Washington, D.C.

Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents. EPA-600/2-76-220, U.S. Environmental Protection Agency, Ada, Oklahoma, December 1976. 510 pp.

Foundry Industry (contractor's draft report). Contract No. 68-01-4379, U.S. Environmental Protection Agency, Washington, D.C., May 1979.

Interim Final Supplement for Pretreatment to the Development Document for the Petroleum Refining Industry Existing Point Source Category. EPA-440/1-76, U.S. Environmental Protection Agency, March 1977.

Kleper, M. H., A. Z. Gollan, R. L. Goldsmith and K. J. McNulty. Assessment of Best Available Technology Economically Achievable for Synthetic Rubber Manufacturing Wastewater. EPA-600/2-78-192, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1978. 182 pp.

Kleper, M. H., R. L. Goldsmith, and A. Z. Gollan. Demonstration of Ultrafiltration and Carbon Adsorption for Treatment of Industrial Laundering Wastewater. EPA/2-78-177, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1978. 109 pp.

Kleper, M. H., R. L. Goldsmith, T. V. Tran, D. H. Steiner, J. Pecevich, and M. A. Sakillaris. Treatment of Wastewaters from Adhesives and Sealants Manufacturing by Ultrafiltration. EPA-600/2-78-176, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1978.

Klieve, J. R., and G. D. Rawlings. Source Assessment: Textile Plant Wastewater Toxics Study Phase II. Contract No. 68-02-1874, U.S. Environmental Protection Agency, Washington, D.C., April 1979. 127 pp.

Lang, W. C., J. H. Crozier, F. P. Drace, and K. H. Pearson. Industrial Wastewater Reclamation with a 400,000-gallon-per-day Vertical Tube Evaporator. EPA-600/2-76-260, U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1976. 90 pp.

McNulty, K. J., R. L. Goldsmith, A. Gollan, S. Hossain, and D. Grant. Reverse Osmosis Field Test: Treatment of Copper Cyanide Rinse Waters, EPA-600/2-77-170, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1977. 89 pp.

Olem, H. The Rotating Biological Contactor for Biochemical Ferrous Iron Oxidation in the Treatment of Coal Mine Drainage. No. W77-05337, Penn State University, Pennsylvania, November 1975.

Petersen, R. J., and K. E. Cobian. New Membranes for Treating Metal Finishing Effluents by Reverse Osmosis. EPA-600/2-76-197, U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1976. 59 pp.

Preliminary Data Base for Review of BATEA Effluent Limitations Guidelines, NSPS, and Pretratment Standards for the Pulp, Paper, and Paperboard Point Source Category, June 1979, U.S. Environmental Protection Agency, Washington, D.C.

Priority Pollutant Treatibility Review, Industrial Sampling and Assessment. Contract 68-03-2579, U.S. Environmental Protection Agency, Cincinnati, Ohio, July 1978. 47 pp.

Putting Powdered Carbon in Wastewater Treatment. Environmental Science and Technology, Volume II, No. 9, September 1977.

Rawlings, G. D. Evaluation of Hyperfiltration Treated Textile Wastewaters. Contract 68-02-1874, U.S. Environmental Protection Agency, Washington, D.C., November 1978.

Rawlings, G. D. Source Assessment: Textile Plant Wastewater Toxics Study Phase I. EPA-600/2-78-004h, U.S. Environmental Protection Agency, Triangle Park, North Carolina, March 1979. 153 pp.

Review of the Best Available Technology for the Rubber Processing Point Source Category, July 1978, U.S. Environmental Protection Agency, Washington, D.C.

Revised Technical Review of the Best Available Technology, Best Demonstrated Technology, and Pretreatment Technology for the Timber Products Processing Point Source Category (draft contractors report). Contract 68-01-4827, U.S. Environmental Protection Agency, Washington, D.C., October 1978.

Schimmel, C., and D. B. Griffin. Treatment and Disposal of Complex Industrial Wastes. EPA-600/2-76-123. U.S. Environmental Protection Agency, Cincinnati, Ohio, November 1976.

Selected Biodegradation Techniques for Treatment and/or Ultimate Disposal of Organic Materials. EPA-600/2-79-006, U.S. Environmental Protection Agency, Cincinnati, Ohio, March 1973. 377 pp.

Study of Effectiveness of Activated Carbon Technology for the Removal of Specific Materials from Organic Chemical Processes. EPA Contract No. 68-03-2610. Final report on Pilot Operations at USS Chemical, Nevella.

Technical Assistance in the Implementation of the BAT Review of the Coal Mining Industry Point Source Category, March 9, 1979, Environmental Protection Agency, Washington, D.C.

Technical Review of the Best Available Technology, Best Demonstrated Technology, and Pretreatment Technology for the Gum and Wood Chemicals Point Source Category. No. 77-094, Environmental Science and Engineering Incorporation, Gainesville, Florida, 1978.

Technical Study Report BATEA-NSPS-PSES-PSNS: Textile Mills Point Source Category, November 1978. U.S. Environmental Protection Agency.

Technical Support Document for Auto and Other Laundries Industry (draft contractor's report). Contract 68-03-2550, U.S. Environmental Protection Agency, Washington, D.C., August 1979.

Treatment and Recovery of Fluoride Industrial Wastes. No. PB 234 447, Grumman Aerospace Corporation. Bethpage, N.Y., March 1974.

References Used in Volume IV

Innovative and Alternative Technology Assessment Manual, EPA-430/ 9-78-009 (draft), U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978. 252 pp.

Metcalf and Eddy. Wastewater Engineering: Collection Treatment, Disposal. McGraw-Hill Book Co., New York, New York, 1972. pp. 662-667.

Physical, Chemical, and Biological Treatment Techniques for Industrial Wastes, PB 275 287, U.S. Environmental Protection Agency, Washington, D.C., November 1976.

B. REFERENCES EXAMINED BUT NOT USED

Chen, Ching-lin, and R. P. Miele. Wastewater Demineralizing by Continuous Countercurrent Ion Exchange Process. EPA-600/2-77-152 (PB 272 301), U.S. Environmenental Agency, Cincinnati, Ohio, September 1977. 50 pp.

Clark, D. P., L. W. Poulter, O. W. Wilson, and W. N. Christensen. The Treatment and Analysis of Cyanide Wastewater. AFCEC-TR-74-5, Air Force Civil Engineering Center, Tyndall AFB, Florida, February 1975. 122 pp.

Cochrane, W., J. Burm, and A. Dostal. Cannery Wastewater Treatment with Rotating Biological Contactor and Extended Aeration. EPA-R2-73-024 (PB 221 333), U.S. Environmental Protection Agency, Corvallis, Oregon, April 1973. 62 pp.

Eaddy, J. M. Jr., and J. W. Vann. Physical/Chemical Treatment of Textile Finishing Wastewater for Process Reuse. EPA-600/2-78-079 (PB 281 276), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, April 1978. 141 pp.

Ellerbusch, F., and H. S. Skovronek. Oxidative Treatment of Industrial Wastewater. EPA-600/J-77-057 (PB 276 268), US. Environmental Protection Agency, Cincinnati, Ohio. 11 pp.

Gardner, F. H., Jr., and A. R. Williamson. Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment. EPA-600/2-76-227, U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1976. 45 pp.

Handling, Treatment, and Disposal of Wastewater Sludge. In: The USA/USSR Symposium on Handling, Treatment, and Disposal of Wastewater Sludge, Moscow, USSR, 1975. 155 pp.

Harrison, W., R. D. Flotard, and D. L. Ford. Assessment of Activated Carbon For Environmental Control of Trace Organics in Petroleum Refinery Wastewater. Argonne National Laboratory, Argonne, Illinois, March 1979.

Huff, J. E., and J. M. Bigger. Cyanide Removal from Petroleum Refining Waste Water Using Powdered Activated Carbon. 77/08, Illinois Institute for Environmental Quality, Chicago, Illinois, June 1977. 109 pp.

King, A. H., J. Ogea, and J. W. Sutton. Air Flotation-Biological Oxidation of Synthetic Rubber and Latex Waste-Water. (PB 229 480), Firestone Synthetic Rubber and Latex Company, Lake Charles, Louisiana. 136 pp.

Lent, D. S. Study on Power-Laundry Wastewater Treatment, 2118, U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Virginia, November 1974. 96 pp.

McCrodden, B. A. Treatment of Refinery Wastewater Using a Filtration-Activated Carbon System. EPA-600/2-79-066 (PB 295 780), U.S. Environmental Protection Agency, Ada, Oklahoma, March 1979. 91 pp.

Middlebrooks, E. J., D. H. Falkenborg, and R. F. Lewis. Performance and Upgrading of Wastewater Stabilization Ponds; In: Proceedings of a Conference Held August 23-25, 1978, at Utah State University, Logan, Utah. EPA-600/9-79-011 (PB 297 504), U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1979. 226 pp.

Petroska, J. A. High Gradient Magnetic Separation of Food Processing Wastewater. Master's Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1977. 92 pp.

Raphaelian, L. A., and W. Harrison. Trace Organics Variation Across the Wastewater Treatment System of a Class-B Refinery. EPA-600/7-78-125 (PB 285 596), U.S. Environmental Protection Agency and U.S. Department of Energy, Washington, DC, July 1978. 178 pp.

Sephton, H. H. Renovation of Industrial Inorganic Wastewater by Evaporation with Interface Enhancement. EPA-600/2-76-017 (PB 217 281), U.S. Environmental Protection Agency, Cincinnati, Ohio, March 1976. 69 pp.

Smith, R. Design of Ammonia Stripping Towers for Wastewater Treatment. (PB 217 281), U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1970. 69 pp.

Upgrading Textile Operations to Reduce Pollution. Volume 2. Wastewater Treatment Systems (PB 260 566), U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1974.

Versar, Inc. Assessment of Wastewater Management, Treatment Technology, and Assorted Costs for Abatement of PCBs Concentrations in Industrial Effluents. EPA-560/6-76-006 (PB 251 433), U.S. Environmental Protection Agency, Washington, DC, February 1976. 281 pp.

APPENDIX A

NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS

TABLE A-1. NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS

	Number of data sets			
	Data sets with both influent and effluent data			Effluent data (any scale)
Industry/control technology	Full scale	Pilot scale	Bench scale	
Adhesives and Sealants				
Ozonation			1	
Reverse osmosis		1		
Sedimentation	1			
Ultrafiltration		6		
Auto and Other Laundries				
Filtration	3			
Gas flotation with chemical addition	10			
Granular activated carbon adsorption	1	2		
Sedimentation with chemical addition	1			
Ultrafiltration		8		
Coal Gas Washing Process				
Activated sludge		1		
Coal Mining				
Rotating biological contactors		3		
Sedimentation	7			
Coal Tar Distillation Plant				
Activated sludge			1	
Coke Gasification Plant				
Activated sludge			1	
Combined Waste - Petrochemical and Paper Mills				
Activated sludge	1			
Electroplating				
Filtration	2			
Ion exchange	2			
Ozonation	1			
Reverse osmosis		3		
Sedimentation	1			

TABLE A-1 (continued)

Industry/control technology	Number of data sets Data sets with both influent and effluent data Full scale	Pilot scale	Bench scale	Effluent data (any scale)
Foundry Industry				
Filtration	1			
Sedimentation	9			
Sedimentation with chemical addition	1			
Gum and Wood Chemicals				
Granular activated carbon adsorption	1			
Hospitals				
Activated sludge	2			
Trickling filters	8			
Ink Manufacturing				
Sedimentation	1			
Inorganic Chemicals				
Air stripping	1			
Chemical oxidation	2			
Chemical reduction	1			
Filtration	3			
Sedimentation	2			
Sedimentation with chemical addition	2			
Iron and Steel				
Activated sludge	1			
Filtration	3			
Gravity oil separation	1			
Sedimentation	9			
Sedimentation with chemical addition	6			

TABLE A-1 (continued)

Industry/control technology	Number of data sets			
	Data sets with both influent and effluent data			Effluent data (any scale)
	Full scale	Pilot scale	Bench scale	
Leather Tanning and Finishing				
Activated sludge	7			
Lagoon, aerated	1	1		
Lagoon, facultative	2	1		
Sedimentation	1			
Sedimentation with chemical addition	1	1	4	
Trickling filter	3			
Mineral Mining and Processing				
Sedimentation	14			
Nonferrous Metals				
Filtration	1			
Sedimentation with chemical addition	2			
Ore Mining and Dressing				
Chemical oxidation	1	1		
Filtration		22		
Granular activated carbon adsorption		1		
Ion exchange	1	1		
Oxonation		4		
Sedimentation	23			
Sedimentation with chemical addition	8	8		
Organic Chemicals				
Activated sludge	12			
Granulated activated carbon adsorption	1	21		
Ozonation		7		
Solvent extraction	1	6		
Steam stripping		7		
Lagoon, aerated	4			
Lagoon, anaerobic	6	1		

TABLE A-1 (continued)

	Number of data sets			
	Data sets with both influent and effluent data			
Industry/control technology	Full scale	Pilot scale	Bench scale	Effluent data (any scale)
Paint Manufacturing				
Filtration	2			
Lagoon, aerated	1			
Sedimentation	2			
Sedimentation with chemical addition	11			
Pesticide Chemicals				
Granular activated carbon adsorption	7			
Petroleum Refining				
Filtration		6		
Gas flotation	1			
Granular activated carbon adsorption		7	2	
Gravity oil separation				27
Powdered activated carbon adsorption	1	4		
Solvent extraction		8		
Pharmaceutical Manufacturing				
Activated sludge	7			
lagoon, aerated	2			
Powdered activated carbon adsorption	1			
Pulp, Paper, and Paperboard				
Activated sludge	2			
Filtration	2	1		
Gas flotation	1			
Granular activated carbon adsorption		6		
Trickling filter	1			
Rubber Processing				
Activated sludge	1			

TABLE A-1 (continued)

	Number of data sets			
	Data sets with both influent and effluent data			
Industry/control technology	Full scale	Pilot scale	Bench scale	Effluent data (any scale)
Steam Electric Power Generation				
Reverse osmosis	1	6		
Sedimentation	7			
Sedimentation with chemical addition	3	11		
Synthetic Resins				
Activated sludge	2			
Textile Mills				
Activated sludge	43			
Filtration	1	15		
Gas flotation with chemical addition	1			
Granular activated carbon adsorption		12		
Lagoon, aerated	7			
Lagoon, effluent polishing	2			
Ozonation		3		
Powdered activated carbon adsorption	1		10	
Reverse osmosis		12		
Sedimentation		1		
Sedimentation with chemical addition	1	5	2	
Timber Products Processing				
Gravity oil separation				1
Lagoon, aerated	2			
Reverse osmosis		1		
Trickling filter		1		
Ultrafiltration		1		
Tire and Synthetic Rubber				
Reverse osmosis			3	
Trickling filter		1		
Ultrafiltration		8		

TABLE A-1 (continued)

	Number of data sets			
	Data sets with both influent and effluent data			
Industry/control technology	Full scale	Pilot scale	Bench scale	Effluent data (any scale)
Unknown				
Chemical oxidation			1	
Filtration		1		
Granular activated carbon adsorption		3	2	
Powdered activated carbon adsorption	1			
Reverse osmosis		2	2	
Rotating biological contactors		5		
Sedimentation wtih chemical addition		1		
Solvent extraction		5		
Steam stripping		1		
Trickling filter	1	1		
Unspecified Industrial and Domestic Wastewater				
Activated sludge		1		

APPENDIX B

MEDIAN OBSERVED EFFLUENT CONCENTRATIONS

TABLE B-1. MEDIAN OBSERVED EFFLUENT CONCENTRATIONS

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/ sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Conventional pollutants, mg/L:											
BOD_5	190	1,150	4,700						33		3,900
COD	425	18	8,000	23.8			10.5		416		7,970
TSS	58	29	15.2	12.5		17	14		58		480
TKN											
TOC	81	12	1,600	<12			12		105		2,300
Toxic pollutants, mg/L:											
Cyanide, total	40.0	<20		45	2.3		74		0.055		<17
Phenols, total	5.9	0.027	0.19	0.17			0.010				1.3
Toxic pollutants, µg/L:											
Acenaphthene	300	<10[b]									
Acrolein											
Acrylonitrile	30										
Benzene	>100	<91	0.4					<160			46
Benzidine											
Carbon tetrachloride	43							1,800			<10[b]
Chlorobenzene											
1 2,4-Trichlorobenzene		53							150		150
Hexachlorobenzene											
1,2-Dichloroethane		<50						<50	17		
1,1,1-Trichloroethane	190	<27				51		68.5			
Hexachloroethane											
1,1-Dichloroethane	93							<10			
1,1,2-Trichloroethane	>100							11			
1,1,2,2-Tetrachloroethane											35
Chloroethane											
Bis(chloromethyl) ether											
Bis(2-chloroethyl) ether											
2-Chloroethyl vinyl ether											
2-Chloronaphthalene						5					
2,4,6-Trichlorophenol											
p-Chloro-m-cresol		<10[b]				62					
Chloroform	~15	22	11			25		160	22		74
2-Chlorophenol		<10[b]									

(continued)

TABLE B-1 (continued)

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/ sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Toxic pollutants (cont'd), μg/L:									<12		<0.05
1,2-Dichlorobenzene	$<10^b$										
1,3-Dichlorobenzene	$<10^b$										
1,4-Dichlorobenzene											
3,3'-Dichlorobenzidine											
1,1-Dichloroethylene								190			
1,2-*Trans*-dichloroethylene	~20		21								
2,4-Dichlorophenol		48									
1,2-Dichloropropane											
1,3-Dichloropropylene											
2,4-Dimethylphenol	>100	$<10^b$				$<10^b$					
2,4-Dinitrotoluene		10									
2,6-Dinitrotoluene											
1,2-Diphenylhydrazine								390	2,300		<11
Ethylbenzene	>100	1,200	81			$<10^b$					
Fluoranthene	8.5	$<10^b$									
4-Chlorophenyl phenyl ether											
4-Bromophenyl phenyl ether											
Bis(2-chloroisopropyl) ether											
Bis(2-chloroethoxy)methane						26		7,550	≥40		2,000
Methylene chloride	>50	5.6	66								
Methyl chloride		3									
Methyl bromide											
Bromoform											
Dichlorobromomethane											
Dichlorodifluoromethane											
Trichlorofluoromethane											
Dichlorofluoromethane											
Chlorodibromomethane		$<10^b$							<0.3		
Hexachlorobutadiene											
Hexachlorocyclopentadiene											
Isophorone		<46				3					16
Naphthalene	800	$<10^b$							35		
Nitrobenzene		$<10^b$									

(continued)

TABLE B-1 (continued)

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Toxic pollutants (cont'd), µg/L:											
2-Nitrophenol		<10[b]									
4-Nitrophenol											
2,4-Dinitrophenol											
4,6-Dinitro-o-cresol		<10[b]									
N-nitrosodimethylamine											
N-nitrosodiphenylamine		<10[b]									
N-nitroso-di-n-propylamine											
Pentachlorophenol	490	24									
Phenol	>130	33	37			<10		2.0	<5.0		25
Bis(2-ethylhexyl) phthalate	300	12	<10			91	8.7		39		44
Butyl benzyl phthalate		4				<10[b]					
Di-n-butyl phthalate	1.3	30	<6.4			1.0		<10	<5.3		<10
Di-n-octyl phthalate		<10[b]									
Diethyl phthalate	12	22	<0.03			<10					
Dimethyl phthalate		74									
Benz(a)anthracene	55										
Benzo(a)pyrene	10	6				<10					
Benzo(b)fluoranthene		6									
Benzo(k)fluoranthene	150	<5									
Chrysene	11	<10		<10		10					
Acenaphthylene	67					10					
Anthracene/phenanthrene			0.9			<10[b]			0.1		
Benzo(ghi)perylene	550	<10[b]									
Fluorene	80	<10[b]				<10					
Phenanthrene/anthracene	120										
Dibenz(ah)anthracene											
Indeno(1,2,3-cd)pyrene											
Pyrene	16	<10				<10					
Tetrachloroethylene	>60	<10[b]		51				405	45		13
Toluene	>100	10	950					535	14		
Trichloroethylene		56	7.4					12	190		
Vinyl chloride											400
Aldrin											

(continued)

TABLE B-1 (continued)

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Toxic pollutants (cont'd), µg/L:											
Dieldrin											
Chlordane											
4,4'-DDT											<1.0
4,4'-DDE											
4,4'-DDD											
α-Endosulfan											
β-Endosulfan											
Endosulfan sulfate											
Endrin											
Endrin aldehyde											
Heptachlor											<1.0
Heptachlor epoxide											
α-BHC											
β-BHC											
γ-BHC											
δ-BHC											
Aroclor 1242	55.0										
Aroclor 1254											
Aroclor 1221	0.1										
Aroclor 1232	0.5										
Aroclor 1248											
Aroclor 1260											
Aroclor 1016	1.0										
Toxaphene											
Antimony	290	22	43	4	9		<50		72		
Arsenic	7	<5		3.0	<2.0	<10	<9		22	5	62
Beryllium	2	<10		0.85	<0.5				22		
Cadmium	6	<10	100	30	1.1	<20		21	<22		
Chromium	430	17	<14.5	40	2.5	75	27.5	59	<40.5		31
Copper	44	70	200	54	25	40	<25	290	13.5		37
Lead	36	<4	81	40	<3	128	40	200			<200
Mercury	1.3	0.5	70	0.7	0.2		0.5	1,500	<76		2
Nickel	26	40	43	16	3.0	270		50	<40		<1
Selenium	12	<5		8.0	20	<10	10				
Silver	130	<10		2.6	3.1	90	20	11	120		
Thallium	2.0	<5		1.1	<4.0						
Zinc	340	70	3,100	120	<23	260	30	700	2,950		1,100

(continued)

TABLE B-1 (continued)

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/ sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Other pollutants:[d]											
Ammonia-nitrogen, mg/L											
Asbestos, fibers/L		$7.0x10^7$		$6.1x10^6$			$1.4x10^9$				
Chlorine, total residual											
Fluoride, mg/L		320		130,000		130,000					
Oil and grease, mg/L	66.1	9	22	1.25		5.5			11	<16	
Phosphorus, total, mg/L		13.9							22.7		
Aluminum				350							
Iron				1,150							
Molybdenum											
Manganese				200							
Acetaldehyde											
Acetic acid											
Acetone											
Ammonia, mg/L	30										
Butyric acid											
Calcium					30,000						
Chloride					$1.9x10^6$						
Chlorine, total, mg/L											
Chromium (+3)											
Chromium (+6)		5									
Chromium (dissolved)				40		1,300					
Dichlorobenzene											
Methyl ethyl ketone											
Nickel (dissolved)				2,500		2,500					
m-p-Cresol											
o-Cresol											
Propionic acid											
Radium (dissolved), picoCi/L							1.6				
Radium, total, picoCi/L							3.0				
Styrene											
TDS, mg/L											
Xylenes											

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] The concentration was reported as "not detected."

[c] The concentration was reported as "below detection limit."

[d] Units given in μg/L unless otherwise noted.

TABLE B-2. MEDIAN OBSERVED EFFLUENT CONCENTRATIONS

Pollutant[a]	Treatment technique: Gas flotation (dissolved air flotation)	Gas flotation with chemical addition: Alum, polymer	Gas flotation with chemical addition: $CaCl_2$, polymer	Gas flotation with chemical addition: Polymer	Granular media filtration	Ultra-filtration
Conventional pollutants, mg/L:						
BOD_5	250				19	457
COD	509	1,670			195	830
TSS	131				12	54
TKN						
TOC	280				40	246
Toxic pollutants, mg/L:						
Cyanide, total	2,300		260	25	20	5,000
Phenols, total	23				0.032	79.1
Toxic pollutants, µg/L:						
Acenaphthene					0.6	
Acrolein		720			<100	
Acrylonitrile						
Benzene			100	12	<8.5	
Benzidine						
Carbon tetrachloride			1		30	
Chlorobenzene					230	
1,2,4-Trichlorobenzene					94	
Hexachlorobenzene						
1,2-Dichloroethane					170	
1,1,1-Trichloroethane			14	<6	300	
Hexachloroethane						
1,1-Dichloroethane					180	
1,1,2-Trichloroethane					2,100	
1,1,2,2-Tetrachloroethane					0.8	
Chloroethane						
Bis(chloromethyl) ether						
Bis(2-chloroethyl) ether						
2-Chloroethyl vinyl ether						
2-Chloronaphthalene		16			17	
2,4,6-Trichlorophenol			3		69	
p-Chloro-m-cresol					45	
Chloroform	<3[c]	19	8	24	59	
2-Chlorophenol				2	2	
1,2-Dichlorobenzene					5.4	
1,3-Dichlorobenzene			27			
1,4-Dichlorobenzene						

(continued)

TABLE B-2 (continued)

Pollutant[a]	Treatment technique					
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition			Granular media filtration	Ultra-filtration
		Alum, polymer	$CaCl_2$, polymer	Polymer		
Toxic pollutants (cont'd), µg/L:						
3,3'-Dichlorobenzidine						
1,1-Dichloroethylene					<2.0	
1,2-Trans-dichloroethylene					47	
2,4-Dichlorophenol				6	1.1	
1,2-Dichloropropane					1.0	
1,3-Dichloropropylene						
2,4-Dimethylphenol			<0.1	28	0.9	
2,4-Dinitrotoluene						
2,6-Dinitrotoluene						
1,2-Diphenylhydrazine						
Ethylbenzene	<10[b]		77	160	<0.20	
Fluoranthene				0.5	0.14	
4-Chlorophenyl phenyl ether						
4-Bromophenyl phenyl ether						
Bis(2-chloroisopropyl) ether						
Bis(2-chloroethoxy)methane						
Methylene chloride			500	22	19	
Methyl chloride				30		
Methyl bromide						
Bromoform						
Dichlorobromomethane						
Dichlorodifluoromethane						
Trichlorofluoromethane					8.5	
Dichlorofluoromethane						
Chlorodibromomethane						
Hexachlorobutadiene						
Hexachlorocyclopentadiene						
Isophorone			<10[b]			
Naphthalene	380		790	<5	<10	
Nitrobenzene						
2-Nitrophenol						
4-Nitrophenol						
2,4-Dinitrophenol						
4,6-Dinitro-o-cresol						
N-nitrosodimethylamine						
N-nitrosodiphenylamine			620		0.4	

(continued)

TABLE B-2 (continued)

Pollutant[a]	Treatment technique					
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition			Granular media filtration	Ultrafiltration
		Alum, polymer	$CaCl_2$, polymer	Polymer		
Toxic pollutants (cont'd), µg/L:						
N-nitroso-di-n-propylamine						
Pentachlorophenol			27	19	10.0	
Phenol	1,200		100	18	2.8	
Bis(2-ethylhexyl) phthalate	570		610	60	15	
Butyl benzyl phthalate	<10[b]		<0.03	<0.03	6	
Di-n-butyl phthalate			160	<5	2.8	
Di-n-octyl phthalate			33	11	2	
Diethyl phthalate	<10[b]				0.8	
Dimethyl phthalate					<0.03	
Benz(a)anthracene						
Benzo(a)pyrene					0.5	
Benzo(b)fluoranthene						
Benzo(k)fluoranthene					0.1	
Chrysene						
Acenaphthylene						
Anthracene/phenanthrene	600		66	2	0.5	
Benzo(ghi)perylene						
Fluorene					10,000	
Phenanthrene/anthracene	600		66	2	0.5	
Dibenz(ah)anthracene						
Indeno(1,2,3-cd)pyrene						
Pyrene				0.3	0.3	
Tetrachloroethylene			660	2	21	
Toluene	<10[b]		850		2.7	
Trichloroethylene			18		3.0	
Vinyl chloride						
Aldrin						
Dieldrin						
Chlordane					24	
4,4'-DDT						
4,4'-DDE						
4,4'-DDD						
α-Endosulfan						
β-Endosulfan						
Endosulfan sulfate						
Endrin						

(continued)

TABLE B-2 (continued)

Pollutant[a]	Treatment technique					
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition			Granular media filtration	Ultra-filtration
		Alum, polymer	$CaCl_2$, polymer	Polymer		
Toxic pollutants (cont'd), µg/L:						
Endrin aldehyde						
Heptachlor						
Heptachlor epoxide						
α-BHC					3.7	
β-BHC					55	
γ-BHC						
δ-BHC						
Aroclor 1242	0.5				480	
Aroclor 1254					650	
Aroclor 1221						
Aroclor 1232						
Aroclor 1248					480	
Aroclor 1260						
Aroclor 1016	7.9					
Toxaphene						
Antimony			<20		47	
Arsenic			<10		7	
Beryllium					1.6	
Cadmium			<3	5	5	<10
Chromium	290		280	28	34	2,900
Copper	37		330	66	32	<500
Lead	150		120	>20	61	<1,000
Mercury	0.6		<0.2		0.6	0.6
Nickel	27		<50	48	47	<500
Selenium	8.5		2		41	
Silver			<17	29	9	
Thallium			50	14		
Zinc	27,000		≤130	130	150	<1,000
Other pollutants:						
Ammonia-nitrogen, mg/L						
Asbestos, fibers/L					$2.5x10^6$	
Chlorine, total residual, µg/L						

(continued)

TABLE B-2 (continued)

Pollutant[a]	Treatment technique					
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition			Granular media filtration	Ultra-filtration
		Alum, polymer	$CaCl_2$, polymer	Polymer		
Other pollutants (cont'd):[d]						
Fluoride						
Oil and grease, mg/L	170				11	38
Phosphorus, total, mg/L					2	
Aluminum						
Iron						
Molybdenum						
Manganese						
Acetaldehyde						
Acetic acid						
Acetone						
Ammonia, mg/L						
Butyric acid						
Calcium						
Chloride						
Chlorine, total						
Chromium (+3)					610	
Chromium (+6)					20	
Chromium (dissolved)						
Dichlorobenzene		≤ 10	260			
Methyl ethyl ketone						
Nickel (dissolved)						
m-p-Cresol						
o-Cresol						
Propionic acid						
Radium (dissolved), PicoCi/L						
Radium, total, PicoCi/L						
Styrene						
TDS, mg/L						
Xylenes	<10[b]					

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] The concentration was reported as "not detected."

[c] The concentration was reported as "below detection limit."

[d] Units given in μg/L unless otherwise noted.

TABLE B-3. MEDIAN OBSERVED EFFLUENT CONCENTRATIONS

	Treatment technique								
			Lagoons (Stabilization Ponds)						
Pollutant[a]	Activated sludge	Trickling filters	Aerated	Anaerobic	Facultative	Tertiary polishing	Rotating biological contactors	Steam stripping	Solvent extraction
Conventional pollutants, mg/L:									
BOD_5	49	27	90	488	152		18		
COD	425	623	591	2,300	1,410	202	750	173	1,140
TSS	92	45	155		76	25	62		
TKN	174		64		68		15		
TOC	280		126					110	43.5
Toxic pollutants, mg/L:									
Cyanide, total	28	16	101						
Phenols, total	0.028	<1.0	0.0105			0.04			
Toxic pollutants, μg/L:									
Acenaphthene	<1.02		4						
Acrolein									
Acrylonitrile									
Benzene	<0.02		7.5	5,000					8,100
Benzidine	4		7.0						
Carbon tetrachloride	<5.05								
Chlorobenzene	<0.02								
1,2,4-Trichlorobenzene	6.3								
Hexachlorobenzene	0.28		<10[c]						
1,2-Dichloroethane								9,000	31,500
1,1,1-Trichloroethane	<2.0		22					42,000	
Hexachloroethane									
1,1-Dichloroethane	<6.5								
1,1,2-Trichloroethane	<10							10[b]	16,000
1,1,2,2-Tetrachloroethane	<10							33,000	2,000
Chloroethane									
Bis(chloromethyl) ether	<10								
Bis(2-chloroethyl) ether	<10								
2-Chloroethyl vinyl ether									
2-Chloronaphthalene	1.0		<10[c]						
2,4,6-Trichlorophenol	41	2	<10[b]						
p-Chloro-m-cresol	0.85								
Chloroform	32	19	<10[b]					<10[b]	
2-Chlorophenol	5.45								

(continued)

TABLE B-3 (continued)

Pollutant[a]	Treatment technique								
	Activated sludge	Trickling filters	Lagoons (Stabilization Ponds)				Rotating biological contactors	Steam stripping	Solvent extraction
			Aerated	Anaerobic	Facultative	Tertiary polishing			
Toxic pollutants (cont'd), μg/L:									
1,2-Dichlorobenzene	<0.5		$<10^b$						
1,3-Dichlorobenzene									
1,4-Dichlorobenzene	0.125		$<10^b$						
3,3'-Dichlorobenzidine									
1,1-Dichloroethylene									
1,2-*Trans*-dichloroethylene								16,000	
2,4-Dichlorophenol	<10								
1,2-Dichloropropane	<5.3								
1,3-Dichloropropylene									
2,4-Dimethylphenol	9								
2,4-Dinitrotoluene			3						
2,6-Dinitrotoluene	390		2						
1,2-Diphenylhydrazine	340		14						
Ethylbenzene	<0.2		$<10^b$						4,000
Fluoranthene	2.0		$<10^c$						
4-Chlorophenyl phenyl ether									
4-Bromophenyl phenyl ether	18								
Bis(2-chloroisopropyl) ether			$<10^c$						
Bis(2-chloroethoxy)methane			$<10^c$						
Methylene chloride	9.0	1.0	130						
Methyl chloride			<5						
Methyl bromide									
Bromoform	3.0								
Dichlorobromomethane	<5.75								
Dichlorodifluoromethane									
Trichlorofluoromethane	2,100					$<10^b$			
Dichlorofluoromethane									
Chlorodibromomethane									
Hexachlorobutadiene									
Hexachlorocyclopentadiene									
Isophorone	<10		2						
Naphthalene	<2.3	55	$<10^c$			$<10^b$			
Nitrobenzene			$<10^c$						

(continued)

TABLE B-3 (continued)

Pollutant[a]	Treatment technique								
	Acti-vated sludge	Trickling filters	Lagoons (Stabilization Ponds)				Rotating biological contactors	Steam stripping	Solvent extraction
			Aerated	Anaerobic	Facul-tative	Tertiary polishing			
Toxic pollutants (cont'd), µg/L:									
2-Nitrophenol	<0.4								
4-Nitrophenol	<0.99		<10						
2,4-Dinitrophenol									
4,6-Dinitro-o-phenol									
N-nitrosodimethylamine									
N-nitrosodiphenylamine	0.84		1						
N-nitroso-di-n-propylamine	10.5								
Pentachlorophenol	<0.04	3	$<10^b$						190,000
Phenol	<0.07	37	$<10^c$						
Bis(2-ethylhexyl) phthalate	13	6	$<10^c$			<11			
Butyl benzyl phthalate	11		6						
Di-n-butyl phthalate	29	6	1						
Di-n-octyl phthalate	5,000								
Diethyl phthalate	<0.03	140	4						
Dimethyl phthalate	<0.03		6						
Benz(a)anthracene									
Benzo(a)pyrene			2						
Benzo(b)fluoranthene									
Benzo(k)fluoranthene									
Chrysene									
Acenaphthylene	1.0		5						
Anthracene/phenanthrene	1.4		3						
Benzo(ghi)perylene									
Fluorene	<0.02		0.2						
Dibenz(ah)anthracene									
Indeno(1,2,3-cd)pyrene	<0.02								
Pyrene	0.2		1.0						
Tetrachloroethylene			$<10^b$					$<10^b$	1,950
Toluene	24		$<10^b$						
Trichloroethylene	17		$<10^b$					$<10^b$	
Vinyl chloride									
Aldrin									
Dieldrin									
Chlordane									
4,4'-DDT									

(continued)

TABLE B-3 (continued)

	Treatment technique								
			Lagoons (Stabilization Ponds)						
Pollutant[a]	Activated sludge	Trickling filters	Aerated	Anaerobic	Facultative	Tertiary polishing	Rotating biological contactors	Steam stripping	Solvent extraction
Toxic pollutants (cont'd), µg/L:									
4,4'-DDE									
4,4'-DDD									
α-Endosulfan									
β-Endosulfan									
Endosulfan sulfate									
Endrin									
Endrin aldehyde									
Heptachlor	1.5								
Heptachlor epoxide									
α-BHC									
β-BHC									
γ-BHC									
δ-BHC									
Aroclor 1242									
Aroclor 1254									
Aroclor 1221									
Aroclor 1232									
Aroclor 1248									
Aroclor 1260									
Aroclor 1016									
Toxaphene									
Antimony	3.5		30						
Arsenic	13								
Beryllium			<1						
Cadmium	4.0		<2						
Chromium	28	17	16			<10[b]			
Copper	30	42	26			18			
Lead	61	49	<50			<10[b]			
Mercury	0.7		0.1						
Nickel	40		32						
Selenium	41		<200			18			
Silver	33								
Thallium	29		<33						
Zinc	180		<80			110			

(continued)

TABLE B-3 (continued)

Pollutant[a]	Treatment technique								
	Activated sludge	Trickling filters	Lagoons (Stabilization Ponds) Aerated	Lagoons (Stabilization Ponds) Anaerobic	Lagoons (Stabilization Ponds) Facultative	Lagoons (Stabilization Ponds) Tertiary polishing	Rotating biological contactors	Steam stripping	Solvent extraction
Other pollutants:[d]									
Ammonia-nitrogen, mg/L									
Asbestos, fibers/L									
Chlorine, total residual									
Fluoride									
Oil and grease, mg/L	25		17				29		
Phosphorus, total, mg/L	3.5						3.4		
Aluminum									
Iron									
Molybdenum									
Manganese									
Acetaldehyde				35					
Acetic acid				2,300					
Acetone									16,000
Ammonia									
Butyric acid				320					
Calcium									
Chloride									
Chlorine									81,000
Chromium (+3)									
Chromium (+6)									
Chromium (dissolved)									
Dichlorobenzene									
Methyl ethyl ketone									2,500,000
Nickel (dissolved)									
m-p-Cresol				25,000					
o-Cresol				31,000					
Propionic acid									
Radium (dissolved), picoCi/L									
Radium, total, picoCi/L									
Styrene									<1,000
TDS, mg/L									
Xylenes		2.0							<1,000

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] The concentration was reported as "not detected."

[c] The concentration was reported as "below detection limit."

[d] Units given in μg/L unless otherwise noted.

TABLE B-4. MEDIAN OBSERVED EFFLUENT CONCENTRATIONS

Pollutant[a]	Treatment technique Granular activated carbon absorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Conventional pollutants, mg/L·									
BOD$_5$	12	13				2.7		70	
COD	199	98	565			25.5		213	
TSS	16	54	96	162		<4.5		15	
TKN	2.0								
TOC	83	38				8		543	
Toxic pollutants, mg/L:									
Cyanide, total	<18	20	38		90	22		<320	
Phenols, total	0.017	0.013				0.014		0.021	
Toxic pollutants, µg/L:									
Acenaphthene									
Acrolein		700,000							
Acrylonitrile									
Benzene	9.8	21,000				1.0			
Benzidine									
Carbon tetrachloride									
Chlorobenzene	<0.2	20,000							
1,2,4-Trichlorobenzene	<0.09								
Hexachlorobenzene									
1,2-Dichloroethane	45,000	190,000							
1,1,1-Trichloroethane	<10								
Hexachloroethane									
1,1-Dichloroethane	<10								
1,1,2-Trichloroethane	<10								
1,1,2,2-Tetrachloroethane	4,000								
Chloroethane	46,000								
Bis(chloromethyl) ether									
Bis(2-chloroethyl) ether		44							
2-Chloroethyl vinyl ether									
2-Chloronaphthalene									
2,4,6-Trichlorophenol									
p-Chloro-m-cresol	<0.1								
Chloroform	<10						14		
2-Chlorophenol		190,000	190,000						

(continued)

TABLE B-4 (continued)

Pollutant[a]	Treatment technique								
	Granular activated carbon absorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Toxic pollutants (cont'd), μg/L:									
1,2-Dichlorobenzene	<0.05								
1,3-Dichlorobenzene									
1,4-Dichlorobenzene									
3,3'-Dichlorobenzidine									
1,1-Dichloroethylene									
1,2-*Trans*-dichloroethylene	240							2.1	
2,4-Dichlorophenol									
1,2-Dichloropropane	<5.4	70,000							
1,3-Dichloropropylene									
2,4-Dimethylphenol	<0.1								
2,4-Dinitrotoluene									
2,6-Dinitrotoluene									
1,2-Diphenylhydrazine									
Ethylbenzene	<0.2	18,000							
Fluoranthene	<0.02							0.1	
4-Chlorophenyl phenyl ether									
4-Bromophenyl phenyl ether									
Bis(2-chloroisopropyl) ether									
Bis(2-chloroethoxy)methane									
Methylene chloride	180					5		38	
Methyl chloride						45			
Methyl bromide									
Bromoform									
Dichlorobromomethane									
Dichlorodifluoromethane									
Trichlorofluoromethane	69								
Dichlorofluoromethane									
Chlorodibromomethane									
Hexachlorobutadiene									
Hexachlorocyclopentadiene									
Isophorone		30,000							
Naphthalene		<10[c]							
Nitrobenzene									

(continued)

TABLE B-4 (continued)

Pollutant[a]	Treatment technique								
	Granular activated carbon absorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Toxic pollutants (cont'd), µg/L:									
2-Nitrophenol									
4-Nitrophenol									
2,4-Dinitrophenol									
4,6-Dinitro-o-phenol									
N-nitrosodimethylamine									
N-nitrosodiphenylamine	<0.07								
N-nitroso-di-n-propylamine									
Pentachlorophenol	1.7								
Phenol	0.9	95,000				0.7			
Bis(2-ethylhexyl) phthalate	17	$<10^c$				3.0		100	
Butyl benzyl phthalate	<0.03							<0.03	
Di-n-butyl phthalate	0.4					1.0		1.95	
Di-n-octyl phthalate	55								
Diethyl phthalate	1.4							<0.02	
Dimethyl phthalate						110			
Benz(a)anthracene									
Benzo(a)pyrene	<0.02								
Benzo(b)fluoranthene									
Benzo(k)fluoranthene	<0.02							<0.02	
Chrysene									
Acenaphthylene									
Anthracene/phenanthrene								<0.2	
Benzo(ghi)perylene									
Fluorene									
Dibenz(ah)anthracene									
Indeno(1,2,3-cd)pyrene									
Pyrene	<0.01					18		0.1	
Tetrachloroethylene	32								
Toluene	1.3	67,000				20		0.9	
Trichloroethylene	1.6							2.1	
Vinyl chloride	8,600								
Aldrin									

(continued)

TABLE B-4 (continued)

	Treatment technique								
Pollutant[a]	Granular activated carbon absorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Toxic pollutants (cont'd), μg/L:									
Dieldrin									
Chlordane									
4,4'-DDT									
4,4'-DDE									
4,4'-DDD									
α-Endosulfan									
β-Endosulfan									
Endosulfan sulfate									
Endrin									
Endrin aldehyde									
Heptachlor									
Heptachlor epoxide									
α-BHC	<1								
β-BHC									
γ-BHC									
δ-BHC									
Aroclor 1242									
Aroclor 1254									
Aroclor 1221									
Aroclor 1232									
Aroclor 1248									
Aroclor 1260									
Aroclor 1016									
Toxaphene									
Antimony	42	96				90		613	
Arsenic	5					1		24	
Beryllium	2.7					<2.8			
Cadmium	5.2	10			<10[c]	14.0		250	
Chromium	36	53			35	520		6.3	
Copper	42	14	320		90	40		340	
Lead	35	28	2,500		10	250		<22	
Mercury	0.4	0.6				0.3			
Nickel	86	<10			<10[c]	<10[c]		2,500	
Selenium	13	<30				4			
Silver	22				<10[c]	9		660	
Thallium						2			
Zinc	51	95			400	57		240	

(continued)

TABLE B-4 (continued)

Pollutant[a]	Treatment technique								
	Granular activated carbon absorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlo-rination	Ozonation	Chemical reduction
Other pollutants, μg/L:[d]									
Ammonia-nitrogen, mg/L			120						
Asbestos, fibers/L									
Chlorine, total residual									
Fluoride									
Oil and grease, mg/L	7.8	13				7		14	
Phosphorus, total, mg/L	2.0							1.1	
Aluminum									
Iron									
Molybdenum					1,300				
Manganese									
Acetaldehyde									
Acetic acid									
Acetone									
Ammonia, mg/L									
Butyric acid									
Calcium									
Chloride									
Chlorine, total, g/L									
Chromium (+3)						15			
Chromium (+6)		<20			10	10			
Chromium (dissolved)									
Cyanide									
Dichlorobenzene									
Methyl ethyl ketone									
Nickel (dissolved)									
m-*p*-Cresol									
o-Cresol									
Propionic acid									
Radium (dissolved), picoCi/L					<1.0				
Radium, total, picoCi/L					7.2				
Styrene									
TDS, mg/L									
Xylenes									

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] The concentration was reported as "not detected."

[c] The concentration was reported as "below detection limit."

[d] Units given in μg/L unless otherwise noted.

APPENDIX C

MEDIAN REMOVAL EFFICIENCIES

TABLE C-1. MEDIAN REMOVAL EFFICIENCIES
(Percent)

Pollutant[a]	Gravity oil separation	Clarification/sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
			Treatment technique								
			Clarification/sedimentation with chemical addition								
Conventional pollutants:											
BOD_5		25	2					25	16		0[b]
COD		91	71	14			62	59	61		95
TSS		97	>99	71		69	>89	67	79		97
TKN											
TOC		29	82	18			<49	58	63		82
Toxic pollutants:											
Cyanide, total		29		0[b]		65		0[b]			>78
Phenols, total		45	29	22			0	26	19		0[b]
Acenaphthene		>17									
Acrolein											
Acrylonitrile											
Benzene		>45	0[b]					49			50
Benzidine											
Carbon tetrachloride								94			>17
Chlorobenzene											
1,2,4-Trichlorobenzene		0[b]							90		91
Hexachlorobenzene											
1,2-Dichloroethane								30			
1,1,1-Trichloroethane		29				0[b]		<47			
Hexachloroethane											
1,1-Dichloroethane								>98			
1,1,2-Trichloroethane								0[b]			
1,1,2,2-Tetrachloroethane											
Chloroethane											
Bis(chloromethyl) ether											
Bis(2-chloroethyl) ether											
2-Chloroethyl vinyl ether											
2-Chloronaphthalene											
2,4,6-Trichlorophenol											
p-Chloro-m-cresol		>91				45					
Chloroform		0[b]	0[b]			75		40	0[b]		0[b]
2-Chlorophenol		<88									
1,2-Dichlorobenzene									25		
1,3-Dichlorobenzene											
1,4-Dichlorobenzene											
3,3'-Dichlorobenzidine											

(continued)

TABLE C-1 (continued)

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Toxic pollutants (cont'd):											
1,1-Dichloroethylene		<1[d]						>98			
1,2-*Trans*-dichloroethylene			0[b]					28			
2,4-Dichlorophenol		98									
1,2-Dichloropropane											
1,3-Dichloropropylene											59
2,4-Dimethylphenol		>55				>76					
2,4-Dinitrotoluene		80									
2,6-Dinitrotoluene											
1,2-Diphenylhydrazine											
Ethylbenzene		16	81					75	0[b]		>97
Fluoranthene		>17				>97					
4-Chlorophenyl phenyl ether											
4-Bromophenyl phenyl ether											
Bis(2-chloroisopropyl) ether											
Bis(2-chloroethoxy)methane											
Methylene chloride		77	0[b]	0[b]				91	>72		13
Methyl chloride		84									
Methyl bromide											
Bromoform											
Dichlorobromomethane											
Dichlorodifluoromethane											
Trichlorofluoromethane											
Dichlorofluoromethane											
Chlorodibromomethane											
Hexachlorobutadiene									>50		
Hexachlorocyclopentadiene											
Isophorone		10[c]									
Naphthalene		>70				98					
Nitrobenzene		>52							68		70
2-Nitrophenol		>47									
4-Nitrophenol											
2,4-Dinitrophenol											
4,6-Dinitro-*o*-cresol		>95									
N-nitrosodimethylamine											
N-nitrosodiphenylamine		>77									

(continued)

TABLE C-1 (continued)

Pollutant[a]	Treatment technique										
			Clarification/sedimentation with chemical addition								
	Gravity oil separation	Clarification/sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Toxic pollutants (cont'd):											
N-nitroso-di-n-propylamine											
Pentachlorophenol		55						>96			
Phenol		>99	15			>37		89	>86		<48
Bis(2-ethylhexyl) phthalate		17	>49			98	<48		0^b		0^b
Butyl benzyl phthalate						>99					>99
Di-n-butyl phthalate		0^b	50			99		>99	47		
Di-n-octyl phthalate		>50						>99			
Diethyl phthalate		0^b	>98			>99					
Dimethyl phthalate		49									
Benz(a)anthracene		83									
Benzo(a)pyrene		80				>81					
Benzo(b)fluoranthene		83									
Benzo(k)fluoranthene		>57									
Chrysene						99					
Acenaphthylene											
Anthracene/phenanthrene			0^b			>0			0^b		
Benzo(ghi)perylene		>17									
Fluorene		>79				>99					
Phenanthrene/anthracene		44									
Dibenz(ah)anthracene											
Indeno(1,2,3-cd)pyrene											
Pyrene		>64				87					
Tetrachloroethylene								0	0^b		
Toluene		6	20					40	<49		76
Trichloroethylene			0^b					0^b	10		
Vinyl chloride											
Aldrin											
Dieldrin											
Chlordane											
4,4'-DDT											>52
4,4'-DDE											
4,4'-DDD											
α-Endosulfan											
β-Endosulfan											
Endosulfan sulfate											

(continued)

TABLE C-1 (continued)

Pollutant[a]	Treatment technique										
			Clarification/sedimentation with chemical addition								
	Gravity oil separation	Clarification/sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Toxic pollutants (cont'd):											
Endrin											
Endrin aldehyde											
Heptachlor											>29
Heptachlor epoxide											
α-BHC											
β-BHC											
γ-BHC											
δ-BHC											
Aroclor 1242											
Aroclor 1254											
Aroclor 1221											
Aroclor 1232											
Aroclor 1248											
Aroclor 1260											
Aroclor 1016											
Toxaphene											
Antimony		45	44	40	0[b]		>0		0[b]		
Arsenic		>87		63	67	>0	17		19		0[b]
Beryllium		>85		<38	>83				0[b]		
Cadmium		73	0[b]	<38	<24	50		69	44	>50	
Chromium		>95	>96	88	95	89	72	90	46	>97	
Copper		85	>58	79	83	88	>62	58	>64		
Lead		96	>55	73	>25	58	<42	69			50
Mercury		47	>62	>60	>30		87	74	>34		71
Nickel		>93	35	44	20	76		9	>41		>83
Selenium		83		0	18	50	0[b]				
Silver		>86		10	4.5	0[b]	0[b]	21	<5		
Thallium		52		58	>55						
Zinc		86	93	>82	92	83	65	70	30		>99
Other pollutants:											
Ammonia-nitrogen											
Asbestos		>99		95			38				
Chlorine, total residual											

(continued)

TABLE C-1 (continued)

	Treatment technique										
			Clarification/sedimentation with chemical addition								
Pollutant[a]	Gravity oil separation	Clarification/ sedimentation	Polymer	Lime	Fe^{2+}, lime	Lime, polymer	Barium chloride	Alum, coagulant aid	Alum	Sulfide	Alum, lime
Other pollutants (cont'd):											
Fluoride		51		92							
Oil and grease		40	98	<33		70					>98
Phosphorus, total		3						77			
Aluminum				91							
Iron				>98							
Molybdenum											
Manganese				99							
Acetaldehyde											
Acetic acid											
Acetone											
Ammonia											
Butyric acid											
Calcium				58							
Chloride				26							
Chlorine total											
Chromium (+3)											
Chromium (+6)											
Chromium (dissolved)				99		99					
Dichlorobenzene											
Methyl ethyl ketone											
Nickel (dissolved)				99		99					
m-p-Cresol											
o-Cresol											
Propionic acid											
Radium (dissolved)							>94				
Radium total							>96				
Styrene											
TDS											
Xylenes											

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] Actual data indicate negative removal.

[c] Reported as not detected; assumed to be less than 10 μg/L of influent concentration.

TABLE C-2. MEDIAN REMOVAL EFFICIENCIES
(Percent)

	Treatment technique						
		Gas flotation with chemical addition					
Pollutant[a]	Gas flotation (dissolved air flotation)	Alum	Alum, polymer	$CaCl_2$, polymer	Polymer	Granular media filtration	Ultrafiltration
Conventional pollutants:							
BOD_5	4					22	53
COD	48					21	57
TSS	6					79	>92
TKN	4						
TOC	0^b					12	63
Toxic pollutants:							
Cyanide, total	0^b			3		0^b	0^b
Phenols, total	37						
Acenaphthene						73	
Acrolein						>86	
Acrylonitrile							
Benzene				0^b	33	<15	
Benzidine							
Carbon tetrachloride				50			
Chlorobenzene							
1,2,4-Trichlorobenzene							
Hexachlorobenzene							
1,2-Dichloroethane						0^b	
1,1,1-Trichloroethane					>5	>88	
Hexachloroethane							
1,1-Dichloroethane						0^b	
1,1,2-Trichloroethane							
1,1,2,2-Tetrachloroethane	30					0^b	
Chloroethane							
Bis(chloromethyl) ether							
Bis(2-chloroethyl) ether							
2-Chloroethyl vinyl ether							
2-Chloronaphthalene						0^b	
2,4,6-Trichlorophenol				0^b	10		
p-Chloro-m-cresol							
Chloroform	>0			20	41	0^b	
2-Chlorophenol					0^b		
1,2-Dichlorobenzene						≤50	
1,3-Dichlorobenzene				76			
1,4-Dichlorobenzene							
3,3'-Dichlorobenzidine							

(continued)

TABLE C-2 (continued)

Pollutant[a]	Treatment technique						
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition				Granular media filtration	Ultrafiltration
		Alum	Alum, polymer	$CaCl_2$, polymer	Polymer		
Toxic pollutants (cont'd):							
1,1-Dichloroethylene						>52	
1,2-Trans-dichloroethylene							
2,4-Dichlorophenol				0[b]	0[b]		
1,2-Dichloropropane							
1,3-Dichloropropylene							
2,4-Dimethylphenol					0[b]		
2,4-Dinitrotoluene	>92						
2,6-Dinitrotoluene							
1,2-Diphenylhydrazine							
Ethylbenzene	>99			31	65	82	
Fluoranthene					0[b]		
4-Chlorophenyl phenyl ether							
4-Bromophenyl phenyl ether							
Bis(2-chloroisopropyl) ether							
Bis(2-chloroethoxy)methane							
Methylene chloride				0	61		
Methyl chloride					0[c]		
Methyl bromide							
Bromoform							
Dichlorobromomethane							
Dichlorodifluoromethane							
Trichlorofluoromethane						0[b]	
Dichlorofluoromethane							
Chlorodibromomethane							
Hexachlorobutadiene							
Hexachlorocyclopentadiene							
Isophorone				>95			
Naphthalene	18			80	>65	>70	
Nitrobenzene							
2-Nitrophenol							
4-Nitrophenol							
2,4-Dinitrophenol							
4,6-Dinitro-o-phenol							
N-nitrosodimethylamine							
N-nitrosodiphenylamine				66			

(continued)

TABLE C-2 (continued)

Pollutant[a]	Treatment technique						
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition				Granular media filtration	Ultrafiltration
		Alum	Alum, polymer	$CaCl_2$, polymer	Polymer		
Toxic pollutants (cont'd):							
N-nitroso-di-n-propylamine							
Pentachlorophenol							
Phenol	26			57	36		
Bis(2-ethylhexyl) phthalate	0[b]				51	38	
Butyl benzyl phthalate	>99			>99	>99	49	
Di-n-butyl phthalate	>61						
Di-n-octyl phthalate					61		
Diethyl phthalate	>17						
Dimethyl phthalate							
Benz(a)anthracene							
Benzo(a)pyrene	45			83	0[b]	40	
Benzo(b)fluoranthene							
Benzo(k)fluoranthene							
Chrysene							
Acenaphthylene							
Anthracene/phenanthrene	45			83		44	
Benzo(ghi)perylene							
Fluorene						29	
Phenanthrene/anthracene	~45				0[b]		
Dibenz(ah)anthracene							
Indeno(1,2,3-cd)pyrene							
Pyrene					0	0[b]	
Tetrachloroethylene				47	0	93	
Toluene				6	59	17	
Trichloroethylene				22		>37	
Vinyl chloride							
Aldrin							
Dieldrin							
Chlordane							
4,4'-DDT							
4,4'-DDE							
4,4'-DDD							
α-Endosulfan						39	
β-Endosulfan							
Endosulfan sulfate							

(continued)

TABLE C-2 (continued)

Pollutant[a]	Treatment technique						
	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition				Granular media filtration	Ultrafiltration
		Alum	Alum, polymer	$CaCl_2$, polymer	Polymer		
Toxic pollutants (cont'd):							
Endrin							
Endrin aldehyde							
Heptachlor							
Heptachlor epoxide							
α-BHC							
β-BHC							
γ-BHC							
δ-BHC							
Aroclor 1242						0^b	
Aroclor 1254						20	
Aroclor 1221							
Aroclor 1232	0					0^b	
Aroclor 1248						0^b	
Aroclor 1260						0^b	
Aroclor 1016	0^a						
Toxaphene							
Antimony			6	>20	0^b	24	
Arsenic				>13		0	
Beryllium						23	
Cadmium				>96	0^b	55	>83
Chromium	54			≥50	0^b	31	67
Copper	64			79	42	35	>71
Lead	49			98	15	31	>74
Mercury	0^b			57	0	48	16
Nickel	0^b			>55		14	32
Selenium	$-^c$			0^b		0	
Silver	0^b			64	0	0	
Thallium				0^b	$-^c$		
Zinc	11			97	39	43	>78
Other pollutants:							
Ammonia-nitrogen							
Asbestos						>99	
Chlorine, total residual							

(continued)

TABLE C-2 (continued)

Pollutant[a]	Gas flotation (dissolved air flotation)	Gas flotation with chemical addition: Alum	Gas flotation with chemical addition: Alum, polymer	Gas flotation with chemical addition: $CaCl_2$, polymer	Gas flotation with chemical addition: Polymer	Granular media filtration	Ultrafiltration
Other pollutants (cont'd):							
Fluoride							
Oil and grease	4					20	>77
Phosphorus, total						30	
Aluminum							
Iron							
Molybdenum							
Manganese							
Acetaldehyde							
Acetic acid							
Acetone							
Ammonia							
Butyric acid							
Calcium							
Chloride							
Chlorine, total							
Chromium (+3)						95	
Chromium (+6)						0	
Chromium (dissolved)							
Dichlorobenzene							
Methyl ethyl ketone							
Nickel (dissolved)							
m-p-Cresol							
o-Cresol							
Propionic acid							
Radium (dissolved)							
Radium, total							
Styrene							
TDS							
Xylenes	>99						

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] Actual data indicate negative removal.

[c] Reported as not detected; assumed to be less than 10 μg/L of influent concentration.

TABLE C-3. MEDIAN REMOVAL EFFICIENCIES
(Percent)

	Treatment technique								
			Lagoons (Stabilization Ponds)						
Pollutant[a]	Acti-vated sludge	Trickling filters	Aerated	Anaerobic	Facul-tative	Tertiary polishing	Rotating biological contactors	Steam stripping	Solvent extraction
Conventional pollutants:									
BOD_5	91	92	78	65	87		72		
COD	67	23	63	35	62	26	41	67	50
TSS	25	59	24		80	50	0[b]	72	
TKN	44		77		50		33		
TOC	69		46						35
Toxic pollutants:									
Cyanide, total	0[b]	78	46			>72			
Phenols, total	64	>97	>65			23			69
Acenaphthene	>99		0						
Acrolein									
Acrylonitrile									
Benzene	>96		78	50					97
Benzidine	0		41						
Carbon tetrachloride									
Chlorobenzene	>99								
1,2,4-Trichlorobenzene	49		>0						
Hexachlorobenzene	49		>0						
1,2-Dichloroethane								>99	89
1,1,1-Trichloroethane	>85		96					9	
Hexachloroethane									
1,1-Dichloroethane	>9								
1,1,2-Trichloroethane	9							>99	92
1,1,2,2-Tetrachloroethane	0[b]							0[b]	98
Chloroethane									
Bis(chloromethyl) ether	>83	0							
Bis(2-chloroethyl) ether	>47								
2-Chloroethyl vinyl ether			>0						
2-Chloronaphthalene	50		>47						
2,4,6-Trichlorophenol	0	0[b]	>99						
p-Chloro-m-cresol									
Chloroform	>2	0[b]	>36					>99	
2-Chlorophenol	46								
1,2-Dichlorobenzene	>96		>96						
1,3-Dichlorobenzene									
1,4-Dichlorobenzene	95		>81						
3,3'-Dichlorobenzidine									

(continued)

Date: 6/23/80

TABLE C-3 (continued)

Pollutant[a]	Treatment technique								
	Acti-vated sludge	Trickling filters	Lagoons (Stabilization Ponds)				Rotating biological contactors	Steam stripping	Solvent extraction
			Aerated	Anaerobic	Facul-tative	Tertiary polishing			
Toxic pollutants (cont'd):									
1,1-Dichloroethylene								99	
1,2-Trans-dichloroethylene									
2,4-Dichlorophenol	>25								
1,2-Dichloropropane	>68								
1,3-Dichloropropylene	0[b]								
2,4-Dimethylphenol									
2,4-Dinitrotoluene			0[b]						
2,6-Dinitrotoluene	0[b]		83						
1,2-Diphenylhydrazine	0[b]		0[b]						
Ethylbenzene	95								97
Fluoranthene	0								
4-Chlorophenyl phenyl ether									
4-Bromophenyl phenyl ether									
Bis(2-chloroisopropyl) ether			>0						
Bis(2-chloroethoxy)methane			>60						
Methylene chloride	0[b]	0[b]	65					81	
Methyl chloride			>91						
Methyl bromide									
Bromoform									
Dichlorobromomethane	0								
Dichlorodifluoromethane									
Trichlorofluoromethane	0[b]					>79			
Dichlorofluoromethane									
Chlorodibromomethane									
Hexachlorobutadiene									
Hexachlorocyclopentadiene									
Isophorone	>0		33						
Naphthalene	>99		>29			>82			
Nitrobenzene			>0						
2-Nitrophenol									
4-Nitrophenol			23						
2,4-Dinitrophenol									
4,6-Dinitro-o-cresol									
N-nitrosodimethylamine									
N-nitrosodiphenylamine	>84		67						
N-nitroso-di-n-propylamine	0[b]								

(continued)

TABLE C-3 (continued)

	Treatment technique								
			Lagoons (Stabilization Ponds)						
Pollutant[a]	Activated sludge	Trickling filters	Aerated	Anaerobic	Facultative	Tertiary polishing	Rotating biological contactors	Steam stripping	Solvent extraction
Toxic Pollutants (cont'd):									
Pentachlorophenol		0[b]	>71						
Phenol	99	0[b]	25						
Bis(2-ethylhexyl) phthalate		83	>78			>58			80
Butyl benzyl phthalate			0						
Di-n-butyl phthalate	84	25	0						
Di-n-octyl phthalate	0								
Diethyl phthalate	>99	0[b]	0[b]						
Dimethyl phthalate	>99		25						
Benz(a)anthracene									
Benzo(a)pyrene			33						
Benzo(b)fluoranthene									
Benzo(k)fluoranthene									
Chrysene									
Acenaphthylene			0[b]						
Anthracene/phenanthrene	83								
Benzo(ghi)perylene									
Fluorene	>99		99						
Phenanthrene/anthracene	0	0[b]	0[b]						
Dibenz(ah)anthracene									
Indeno(1,2,3-cd)pyrene	>99								
Pyrene	0[b]		67						
Tetrachloroethylene			>60						
Toluene	18							>99	
Trichloroethylene	>98	0[b]						>99	95
Vinyl chloride									
Aldrin									
Dieldrin									
Chlordane									
4,4'-DDT									
4,4'-DDE									
4,4'-DDD									
α-Endosulfan									
β-Endosulfan									

(continued)

TABLE C-3 (continued)

	Treatment technique								
			Lagoons (Stabilization Ponds)						
Pollutant[a]	Acti-vated sludge	Trickling filters	Aerated	Anaerobic	Facul-tative	Tertiary polishing	Rotating biological contactors	Steam stripping	Solvent extraction
Toxic pollutants (cont'd):									
Endosulfan sulfate									
Endrin									
Endrin aldehyde									
Heptachlor	76								
Heptachlor epoxide									
α-BHC									
β-BHC									
γ-BHC									
δ-BHC									
Aroclor 1242									
Aroclor 1254									
Aroclor 1221									
Aroclor 1232									
Aroclor 1248									
Aroclor 1260									
Aroclor 1016									
Toxaphene									
Antimony	>15		82						
Arsenic	39								
Beryllium			>50						
Cadmium	0		>97						
Chromium	48	0[b]	91			>71			
Copper	56	0[b]	36			0[b]			
Lead	50		>88						
Mercury	>29		82						
Nickel	7		0						
Selenium	0[b]		>50			44			
Silver	20								
Thallium	38		>44						
Zinc	27		55			43			
Other pollutants:									
Ammonia-nitrogen									
Asbestos									
Chlorine total residual									

(continued)

TABLE C-3 (continued)

Pollutant[a]	Treatment technique								
	Activated sludge	Trickling filters	Lagoons (Stabilization Ponds)				Rotating biological contactors	Steam stripping	Solvent extraction
			Aerated	Anaerobic	Facultative	Tertiary polishing			
Other pollutants (cont'd):									
Fluoride									
Oil and grease	92		98				6		
Phosphorus, total	27						11		
Aluminum									
Iron									
Molybdenum									
Manganese									
Acetaldehyde				56					
Acetic acid				0[b]					
Acetone									52
Ammonia									
Butyric acid				0[b]					
Calcium									
Chloride									
Chlorine, total									94
Chromium (+3)									
Chromium (+6)									
Chromium (dissolved)									
Dichlorobenzene									
Methyl ethyl ketone									50
Nickel (dissolved)									
m-p-Cresol									91
o-Cresol									90
Propionic acid				0[b]					
Radium (dissolved)									
Radium, total									
Styrene									>93
TDS									
Xylenes									>97

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] Actual data indicate negative removal.

TABLE C-4. MEDIAN REMOVAL EFFICIENCIES
(Percent)

Pollutant[a]	Granular activated carbon adsorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Conventional pollutants:									
BOD_5	52	96				87		5	
COD	55	91	28			92		51	
TSS	23	0^b	48			>88		15	
TKN	0^b	96							
TOC	60	90				90		10	
Toxic pollutants:									
Cyanide, total	>63	>67	84		97	<42		99	
Phenols, total		>99				2.5		24	
Acenaphthene	>93					73			
Acrolein		30							
Acrylonitrile									
Benzene		95							
Benzidine									
Carbon tetrachloride	89								
Chlorobenzene	>96								
1,2,4-Trichlorobenzene	>99								
Hexachlorobenzene	>99								
1,2-Dichloroethane	>42	81							
1,1,1-Trichloroethane	>99								
Hexachloroethane									
1,1-Dichloroethane	>99								
1,1,2-Trichloroethane	>99								
1,1,2,2-Tetrachloroethane	85								
Chloroethane									
Bis(chloromethyl) ether									
Bis(2-chloroethyl) ether									
2-Chloroethyl vinyl ether									
2-Chloronaphthalene									
2,4,6-Trichlorophenol									
p-Chloro-m-cresol	>83								
Chloroform	74					0^b			
2-Chlorophenol		81							
1,2-Dichlorobenzene	>99								
1,3-Dichlorobenzene									
1,4-Dichlorobenzene									
3,3'-Dichlorobenzidine									

(continued)

TABLE C-4 (continued)

Pollutant[a]	Treatment technique								
	Granular activated carbon adsorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Toxic pollutants (cont'd):									
1,1-Dichloroethylene									
1,2-Trans-dichloroethylene	85							0^b	
2,4-Dichlorophenol									
1,2-Dichloropropane	65	93							
1,3-Dichloropropylene									
2,4-Dimethylphenol	>89								
2,4-Dinitrotoluene									
2,6-Dinitrotoluene									
1,2-Diphenylhydrazine									
Ethylbenzene		84							
Fluoranthene	>83							50	
4-Chlorophenyl phenyl ether						30			
4-Bromophenyl phenyl ether									
Bis(2-chloroisopropyl) ether		53							
Bis(2-chloroethoxy)methane									
Methylene chloride	78					0^b		8	
Methyl chloride									
Methyl bromide									
Bromoform									
Dichlorobromomethane									
Dichlorodifluoromethane									
Trichlorofluoromethane	0^b								
Dichlorofluoromethane									
Chlorodibromomethane									
Hexachlorobutadiene									
Hexachlorocyclopentadiene									
Isophorone		97							
Naphthalene		>96							
Nitrobenzene	>0								
2-Nitrophenol									
4-Nitrophenol									
2,4-Dinitrophenol									
4,6-Dinitro-o-cresol									
N-nitrosodimethylamine									
N-nitrosodiphenylamine	>82								

(continued)

TABLE C-4 (continued)

Pollutant[a]	Granular activated carbon adsorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Toxic pollutants (cont'd):									
N-nitroso-di-n-propylamine									
Pentachlorophenol	78								
Phenol	50	>83							
Bis(2-ethylhexyl) phthalate	0	>97				67		0[b]	
Butyl benzyl phthalate	>97							>97	
Di-n-butyl phthalate	76					75		39	
Di-n-octyl phthalate	91								
Diethyl phthalate	0[b]								
Dimethyl phthalate									
Benz(a)anthracene									
Benzo(a)pyrene	>94							>90	
Benzo(b)fluoranthene									
Benzo(k)fluoranthene	>80							>80	
Chrysene									
Acenaphthylene									
Anthracene/phenanthrene	50					77			
Benzo(ghi)perylene									
Fluorene									
Phenanthrene/anthracene								49	
Dibenz(ah)anthracene									
Indeno(1,2,3-cd)pyrene									
Pyrene	>94							67	
Tetrachloroethylene	<34								
Toluene	24	79				0[b]		31	
Trichloroethylene	50					60		0[b]	
Vinyl chloride	0[b]								
Aldrin									
Dieldrin									
Chlordane									
4,4'-DDT									
4,4'-DDE									
4,4'-DDD									
α-Endosulfan									
β-Endosulfan	<47								
Endosulfan sulfate									

(continued)

TABLE C-4 (continued)

Pollutant[a]	Granular activated carbon adsorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Toxic pollutants (cont'd):									
Endrin									
Endrin aldehyde									
Heptachlor									
Heptachlor epoxide									
α-BHC									
β-BHC									
γ-BHC									
δ-BHC									
Aroclor 1242									
Aroclor 1254									
Aroclor 1221									
Aroclor 1232									
Aroclor 1248									
Aroclor 1260									
Aroclor 1016									
Toxaphene									
Antimony	10	2.5				30		0[b]	
Arsenic	0					>92		24	
Beryllium	0					42			
Cadmium	76	0[b]			>99	0		0[b]	
Chromium	>50	86			>99	67			
Copper	54	61	14		98	82		0[b]	
Lead	2	39			99	>25		>29	
Mercury	0	0[b]	0[b]			4			
Nickel	5	>0			>99	47		0[b]	
Selenium	9					77			
Silver	12					17		0[b]	
Thallium					>99	50			
Zinc	52	6.5			97	97		96	
Other pollutants:									
Ammonia-nitrogen			36						
Asbestos									
Chlorine, total residual									

(continued)

TABLE C-4 (continued)

Pollutant[a]	Treatment technique								
	Granular activated carbon adsorption	Powdered carbon addition with activated sludge	Chemical oxidation	Air stripping	Ion exchange	Reverse osmosis	Dechlorination	Ozonation	Chemical reduction
Other pollutants (cont'd):									
Fluoride									
Oil and grease	19	54				>50		97	
Phosphorus, total	0							0	
Aluminum									
Iron									
Molybdenum					94				
Manganese									
Acetaldehyde									
Acetic acid									
Acetone									
Ammonia									
Butyric acid									
Calcium									
Chloride									
Chlorine, total									
Chromium (+3)						>99			
Chromium (+6)	>60	>60			>99	0[b]			
Chromium (dissolved)									
Dichlorobenzene									
Methyl ethyl ketone									
Nickel (dissolved)									
m-p-Cresol									
o-Cresol									
Propionic acid									
Radium (dissolved)					>99				
Radium, total					99				
Styrene									
TDS									
Xylenes									

Note: Blanks indicate data not available in literature.

[a] Pollutants are listed in the same order as that in the Draft Consolidated Permit Form [3].

[b] Actual data indicate negative removal.

APPENDIX D

POLLUTANT TREATABILITY INDEX

TABLE D-1. POLLUTANT TREATABILITY INDEX

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
BOD_5	Gravity Oil Separation	17	24,000[h]	4.1-17		
	Clarification/Sedimentation	5	980,000	4.2-61	69	4.2-61
	Clarification/Sedimentation with Chemical Addition (Alum)	5	3,600	4.3-25	82	4.3-24
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	10	5,700	4.3-31	65	4.3-31
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	4,700,000	4.3-72	2	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	3,900,000	4.3-27	0[c]	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	250,000	4.4-5	4	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	178,000	4.5-5	49	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	318,000	4.5-11	68	4.5-10
	Gas Flotation with Chemical Addition (Polymer)	2	142,000	4.5-14	>50	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	209,000	4.5-12	84	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	486,000	4.5-13	66	4.5-13
	Granular Media Filtration	14	2,400	4.6-40	51	4.6-46

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
BOD_5 (continued)	Ultrafiltration	12	12,000	4.7-16	88	4.7-16, 4.7-15
	Activated Sludge	93	<5,000[a] <5,000	5.1-44, 5.1-47 5.1-53, 5.1-57, 5.1-66, 5.1-70	>99	5.1-44, 5.1-53, 5.1-57, 5.1-70
	Trickling Filters	11	4,000	5.2-11	98	5.2-11
	Lagoon (Aerated)	16	6,000	5.3-15	>99	5.3-16
	Lagoon (Facultative)	3	53,000	5.3-24	92	5.3-24
	Lagoon (Anaerobic)	5	80,000	5.3-23	90	5.3-23
	Rotating Biological Contactors	4	18,000	5.4-6	82	5.4-6
	Granular Activated Carbon Adsorption	20	1,200	6.1-44	95	6.1-27
	Powdered Carbon Addition (With Activated Sludge)	22	4,000	6.2-14, 6.2-23	>99	6.2-11
	Reverse Osmosis	11	1,000	6.9-15, 6.9-25	92	6.9-15
	Ozonation	4	4,900[b] 5,190,000	6.14-15 6.14-9	10	6.14-9

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
COD	Gravity Oil Separation	27	83,000[h]	4.1-21		
	Clarification/Sedimentation	24	4,000	4.2-50, 4.2-25 4.2-58	>91	4.2-58
	Clarification/Sedimentation with Chemical Addition (Alum)	5	212,000	4.3-24	78	4.3-24
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	5	125,000[a] 9,500,000	4.3-31 4.3-33	80	4.3-35
	Clarification/Sedimentation with Chemical Addition (Lime)	5	8,000	4.3-50	84	4.3-51
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	2,000	4.3-70	>99	4.3-70
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	4,000	4.3-38	67	4.3-38
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	8,000,000	4.3-72	71	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	7,970,000	4.3-27	95	4.3-27
	Gas flotation (Dissolved Air Flotation)	2	18,000	4.4-6	95	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	2,110,000	4.5-5	17	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	5	1,100,000	4.5-10	78	4.5-10
	Gas Flotation with Chemical Addition (Polymer)	2	459,000[a] 725,000	4.5-14 4.5-15	31	4.5-15

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
COD (continued)	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	600,000	4.5-12	87	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	410,000	4.5-13	89	4.5-13
	Granular Media Filtration	23	29,000^a 36,000	4.6-31 4.6-44	75	4.6-43
	Ultrafiltration	11	444,000	4.7-16	99	4.7-16
	Activated Sludge	84	45,000	5.1-61	96	5.1-28, 5.1-34
	Trickling Filters	3	290,000	5.2-14	77	5.2-15
	Lagoon (Aerated)	10	92,000	5.3-15	>99	5.3-16
	Lagoon (Facultative)	2	717,000	5.3-24	68	5.3-24
	Lagoon (Anaerobic)	4	348,000	5.3-23	47	5.3-23
	Lagoon (Tertiary)	2	142,000^b 263,000	5.3-26 5.3-25	52	5.3-25
	Rotating Biological Contactors	4	340,000	5.4-6	54	5.4-6
	Steam Stripping	6	118,000	5.5-14	72	5.5-14
	Solvent Extraction	4	699,000	5.6-12	74	5.6-8
	Granular Activated Carbon Adsorption	41	11,000	6.1-33	99	6.1-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
COD (continued)	Powdered Carbon Addition (With Activated Sludge)	26	33,000	6.2-19	98	6.2-11
	Chemical Oxidation	7	441,000	6.3-16	39	6.3-16
	Reverse Osmosis	18	6,000	6.9-15	>99	6.9-29
	Ozonation	4	17,000	6.14-15	92	6.14-15
	Gravity Oil Separation	16	17,000[h] 295,000[b]	4.1-30 4.1-5	0[c]	4.1-5
TSS	Clarification/Sedimentation	73	<1,000	4.2-50, 4.2-58	>99	4.2-20, 4.2-23, 4.2-28, 4.2-46, 4.2-47, 4.2-48, 4.2-50, 4.2-51, 4.2-52, 4.2-53, 4.2-54, 4.2-56, 4.2-58, 4.2-62,
	Clarification/Sedimentation with Chemical Addition (Alum)	5	28,000	4.3-24, 4.3-26	99	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	46,000	4.3-31	99	4.3-33
	Clarification/Sedimentation with Chemical Addition (Lime)	12	4,000	4.3-53	99	4.3-50

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
TSS (continued)	Clarification/Sedimentation with Chemical Addition (Alum, Lime, Polymer)	1	100,000	4.3-30	>99	4.3-30
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	7	5,000	4.3-70	>99	4.3-70
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	<1,000	4.3-37	90	4.3-38
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	39,000	4.3-72	>99	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	480,000	4.3-27	97	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	131,000	4.5-5	6	4.5-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	742,000[b]	4.5-15	83	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	6	18,000	4.5-10	98	4.5-10
	Gas Flotation with Chemical Addition (Polymer)	2	32,000	4.5-14	84	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	86,000	4.5-12	88	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	61,000	4.5-13	89	4.5-13

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency %	Volume III page(s)
TSS (continued)	Granular Media Filtration	40	<1,000	4.6-24, 4.6-25, 4.6-38	>99	4.6-13, 4.6-16, 4.6-23, 4.6-38
	Ultrafiltration	12	2,400	4.7-14	>99	4.7-10, 4.7-13, 4.7-14, 4.7-15
	Activated Sludge	74	6,000	5.1-51	96	5.1-24
	Trickling Filters	1	45,000	5.2-12	59	5.2-12
	Lagoon (Aerated)	13	3,000	5.3-15	99	5.3-15
	Lagoon (Facultative)	2	48,000	5.3-24	86	5.3-24
	Lagoon (Tertiary)	2	22,000	5.3-25	76	5.3-25
	Rotating Biological Contactors	8	23,000	5.4-5	35	5.4-6
	Granular Activated Carbon Adsorption	28	<1,300	6.1-33	99	6.1-27
	Powdered Carbon Addition (With Activated Sludge)	4	17,000	6.2-8	96	6.2-8
	Chemical Oxidation	2	33,300	6.3-12	97	6.3-12
	Air Stripping	1	162,000[b]	6.4-6	0[c]	6.4-6
	Reverse Osmosis	2	<4,000[a] <5,000	6.9-15 6.9-15	>90	6.9-15
	Ozonation	4	3,000	6.14-15	33	6.14-15
TKN	Activated Sludge	6	27,000	5.1-26	63	5.1-24
	Lagoon (Aerated)	2	22,000	5.3-13	79	5.3-12
	Lagoon (Facultative)	2	35,000	5.3-24	67	5.3-24

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
TKN (continued)	Rotating Biological Contactors	5	6,000	5.4-6	57	5.4-6
	Powdered Carbon Addition (With Activated Sludge)	1	28,000	6.2-11	96	6.2-11
	Reverse Osmosis	1	<3,200	6 9-29	>0	6.9-29
TOC	Gravity Oil Separation	25	$25,000^i$	4.1-21		
	Clarification/Sedimentation	20	1,000	4.2-57	>99	4.2-25
	Clarification/Sedimentation with Chemical Addition (Alum)	4	72,000	4.3-24, 4.3-25	80	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	40,000	4.3-31	71	4.3-33
	Clarification/Sedimentation with Chemical Addition (Lime)	3	9,000	4.3-54	37	4.3-53
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	7,000	4.3-70	22	4.3-70
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	7,000	4.3-37	98	4.3-37
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	1,600,000	4.3-72	82	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	2,300,000	4.3-27	82	4.3-27
	Clarification/Sedimentation with Chemical Addition (Alum, Lime, Polymer)	1	2,500,000	4.3-30	74	4.3-30
	Clarification/Sedimentation with Chemical Addition (Alum, Lime, Ferric Chloride)	1	1,590,000	4.3-29	66	4 3-29

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
TOC (continued)	Gas Flotation (Dissolved Air Flotation)	1	280,000	4.5-5	0[c]	4.5-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	544,000	4.5-5	25	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	4	155,000[b] 270,000	4.5-11 4.5-10	72	4.5-9
	Gas Flotation with Chemical Addition (Polymer)	1	87,000	4.5-14	36	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	177,000	4.5-12	77	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	160,000	4.5-13	73	4.5-13
	Granular Media Filtration	17	10,000[a] 21,000	4.6-40 4.6-10	49	4.6-30
	Ultrafiltration	15	66,000	4.7-16	97	4.7-11
	Activated Sludge	14	35,000	5.1-29	97	5.1-28
	Lagoon (Aerated)	4	47,000	5.3-66	99	5.3-16
	Steam Stripping	40	14,000	5.5-15	94	5.5-15
	Solvent Extraction	6	37,000	5.6-10	49	5.6-10
	Granular Activated Carbon Adsorption	45	2,900	6.1-38	99	6.1-27
	Powdered Carbon Addition (With Activated Sludge)	25	9,000	6.2-23	97	6.2-19

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
TOC (continued)	Reverse Osmosis	17	5,000^a	6.9-23	97	6.9-15
	Ozonation	33	15,000	6.14-15	>75	6.14-14
Total cyanide	Gravity Oil Separation	15	10^h 13	4.1-22, 4.1-23 4.1-24 4.1-5	13	4.1-5
	Clarification/Sedimentation	12	2	4.2-29	>90	4.2-46, 4.2-47
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	74^b	4.3-32	0^c	4.3-32
	Clarification/Sedimentation with Chemical Addition (Lime)	1	45^b	4.3-54	0^c	4.3-54
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	3	2	4.3-67	89	4.3-67
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	2	<4^a 30	4.3-28 4.3-27	80	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	2,300^b	4.4-5	0^c	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	≤10	4.5-5	≥61	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	54	4.5-6	5	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	25	4.5-14	14	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	≤32	4.5-12	≥30	4.5-12
	Granular Media Filtration	11	10	4.6-4	>99	4.6-16
	Ultrafiltration	1	5,000^b	4.7-9	0^c	4.7-9

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Total cyanide (continued)	Activated Sludge	24	<4	5.1-47, 5.1-63 5.1-44	>90	5.1-59
	Trickling Filters	1	16	5.2-13	79	5.2-13
	Lagoon (Aerated)	2	52	5.3-18	91	5.3-18
	Granular Activated Carbon Adsorption	7	<2[a]	6.1-43	>90	6.1-43
	Powdered Carbon Addition (With Activated Sludge)	3	<20	6.2-6	69	6.2-9
	Chemical Oxidation	17	<2	6.3-16	>99	6.3-12
	Air Stripping	1	51,000	6.4-5	60	6.4-5
	Ion Exchange	2	40	6.7-11	99	6.7-11
	Reverse Osmosis	10	1	6.9-9	97	6.9-7
	Ozonation	50	<2[a] 80	6.14-17 6.14-10	>99	6.14-10
Total phenols	Gravity Oil Separation	29	63[h] 54,000	4.1-32 4.1-5	0[a]	4.1-5
	Clarification/Sedimentation	19	6[b] 84,000	4.2-13 4.2-53 4.2-50	96	4.2-23, 4.2-28
	Clarification/Sedimentation with Chemical Addition (Alum)	4	16	4.3-25	31	4.3-26
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	5	28	4.3-31	60	4.3-33

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Total phenols (continued)	Clarification/Sedimentation with Chemical Addition (Lime)	2	12	4.3-53	33	4.3-53
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	1	10	4.3-38	0	4.3-38
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	82[b] 300	4.3-72 4.3-73	58	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	1,300[b]	4.3-27	0[c]	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	23,000	4.4-5	4	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	94	4.5-5	13	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	4	<1	4.5-7	>94	4.5-7
	Gas Flotation with Chemical Addition (Polymer)	2	26	4.5-5	72	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	1,090[b]	4.5-12	0[c]	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	34	4.5-13	48	4.5-13
	Granular Media Filtration	19	1.1[a] 13	4.6-28 4.6-10	65	4.6-42
	Ultrafiltration	4	44,600	4.7-10	82	4.7-10
	Activated Sludge	31	7	5.1-61	>99	5.1-18, 5.1-21,

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Total phenols (continued)	Trickling Filters	3	<1,000	5.2-15	>97	5.2-15
	Lagoon (Aerated)	2	3	5.3-16	>99	5.3-16
	Lagoon (Tertiary)	2	28	5.3-25	46	5.3-25
	Solvent Extraction	6	200	5.6-13	>99	5.6-13
	Granular Activated Carbon Adsorption	19	<5	6.1-34, 6.1-35	99	6.1-36
	Powdered Carbon Addition (With Activated Sludge)	4	<10	6.2-6	>99	6.2-6, 6.2-9, 6.2-10
	Reverse Osmosis	6	<1	6.9-19	81	6.9-18
	Ozonation	3	13	6.14-12	>99	6.14-14
Acenaphthene	Granular Media Filtration	1	0.6	4.6-40	73	4.6-40
	Activated Sludge	10	<0.04	5.1-48, 5.1-52, 5.1-55, 5.1-66, 5.1-68	>99	5.1-48, 5.1-52, 5.1-66, 5.1-68
	Lagoon (Aerated)	1	4	5.3-14	0	5.3-14
	Granular Activated Carbon Adsorption	1	<0.04	6.1-38	>93	6.1-38
	Reverse Osmosis	3	0.8	6.9-20, 6.9-21	99	6.9-20
Acrolein	Gas Flotation with Chemical Addition (Alum, Polymer)	1	720[b]	4.5-6	0[c]	4.5-6
	Granular Media Filtration	1	<100	4.6-9	>86	4.6-9
	Powdered Carbon Addition (With Activated Sludge)	1	700,000	6.2-24	30	6.2-24

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Acrylonitrile	Gravity Oil Separation	1	30^h	4.1-33		
Benzene	Gravity Oil Separation	3	>100	4.1-27		
	Clarification/Sedimentation	2	$<10^d$	4.2-14, 4.2-36	56	4.2-36
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	2	$<10^d$	4.3-35	>97	4.3-35
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	0.4^b	4.3-73	0^c	4.3-73
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	46	4.3-27	50	4.3-27
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	2	5^b 200^b	4.5-6 4.5-9	0^c	4.5-6, 4.5-21
	Gas Flotation with Chemical Addition (Polymer)	1	12	4.5-15	33	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	120^b	4.5-12	0^c	4.5-12
	Granular Media Filtration	6	$0.5^{a,b}$ $<10^d$	4.6-27 4.6-36	>99	4.6-27
	Activated Sludge	9	<0.2	5.1-47, 5.1-69	>99	5.1-69
	Lagoon (Aerated)	2	<5	5.3-20	>95	5.3-16
	Lagoon (Anaerobic)	1	5,000	5.3-22	50	5.3-22
	Solvent Extraction	6	2,400	5.6-12	97	5.6-12, 5.6-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Benzene (continued)	Granular Activated Carbon Adsorption	3	<0.2	6.1-39	>80	6.1-39
	Powdered Carbon Addition (With Activated Sludge)	1	21,000	6.2-24	95	6.2-24
	Reverse Osmosis	3	0.4	6.9-21	80	6.9-21
Benzidine	Activated Sludge	1	4	5.1-19	0[c]	5.1-19
	Lagoon (Aerated)	1	7	5.3-14	41	5.3-14
Carbon tetrachloride	Gravity Oil Separation	1	43[b]	4.1-5	0[c]	4.1-5
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	1,800	4.3-32	94	4.3-32
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<10[d]	4.3-27	>17	4.3-27
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	410	4.5-5	76	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	1	4.5-6	50	4.5-6
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	36[b]	4.5-12	0[c]	4.5-12
	Granular Media Filtration	3	<10[a,d] 30	4.6-27 4.6-9	93	4.6-9
	Activated Sludge	2	0.1	5.1-37	>99	5.1-23

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Chlorobenzene	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	57[b]	4.5-12	0[c]	4.5-12
	Granular Media Filtration	2	4.8[b]	4.6-43	0[c]	4.6-14, 4.6-43
	Activated Sludge	6	<0.2	5.1-47, 5.1-61, 5.1-63, 5.1-68	>99	5.1-61, 5.1-63
1,2,4-Trichlorobenzene	Granular Activated Carbon Adsorption	1	<0.2	6.1-43	>96	6.1-43
	Clarification/Sedimentation	1	53[b]	4.2-30	0[c]	4.2-30
	Clarification/Sedimentation with Chemical Addition (Alum)	1	150	4.3-24	90	4.3-24
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	150	4.3-28	91	4.3-28
	Granular Media Filtration	1	94	4.6-41	37	4.6-41
	Activated Sludge	11	<0.09	5.1-56	>99	5.1-56, 5.1-62, 5.1-66, 5.1-70
Hexachlorobenzene	Granular Activated Carbon Adsorption	1	<0.09	6.1-41	>99	6.1-41
	Activated Sludge	4	<0.05	5.1-66, 5.1-69	>97	5.1-66
	Lagoon (Aerated)	1	<10[e]	5.3-14	>0	5.3-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
1,2-Dichloroethane	Clarification/Sedimentation with Chemical Addition (Alum)	1	17[b]	4.3-21	0[c]	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	2	<10[d]	4.3-35	>60	4.3-35
	Granular Media Filtration	1	170[b]	4.6-27	0[c]	4.6-27
	Steam Stripping	45	300	5.5-14	>99	5.5-14
	Solvent Extraction	6	<20,000	5.6-20	>99	5.6-20
	Granular Activated Carbon Adsorption	57	<10[d]	6.1-15, 6.1-18, 6.1-21, 6.1-22 6.1-26	>99	6.1-15, 6.1-16, 6.1-18, 6.1-21, 6.1-22, 6.1-24, 6.1-26
	Powdered Carbon Addition (With Activated Sludge)	1	190,000	6.2-24	81	6.2-24
1,1,1-Trichloroethane	Gravity Oil Separation	1	190[b]	4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	2	<10[d]	4.2-25	>57	4.2-36
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	2	17	4.3-35	93	4.3-35
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	51	4.3-64	0[c]	4.3-64

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
1,1,1-Trichloroethane (continued)	Gas Flotation With Chemical Addition (Alum, Polymer)	1	860	4.5-5	74	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	14	4.5-6	22	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	2	<2[a] <10	4.5-14 4.5-15	>9	4.5-15
	Granular Media Filtration	4	<10[d]	4.6-27	94	4.6-9
	Activated Sludge	6	<2.0	5.1-46, 5.1-49 5.1-65, 5.1-67	>99	5.1-65
	Lagoon (Aerated)	1	22	5.3-16	96	5.3-16
	Steam Stripping	1	42,000	5.5-10	9	5 5-10
	Granular Activated Carbon Adsorption	2	<10[d]	6.1-26	>99	6.1-26
1,1,-Dichloroethane	Gravity Oil Separation	1	93[b]	4.1-5	0[c]	4.1-5
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	<10[d]	4.3-32	>98	4.3-32
	Granular Media Filtration	1	180[b]	4.6-27	0[c]	4.6-27
	Activated Sludge	2	<3.0	5.1-65	>18	5.1-65
	Granular Activated Carbon Adsorption	9	<10[d]	6.1-15, 6.1-18, 6.1-21, 6.1-22, 6.1-26	>99	6.1-15, 6.1-18, 6.1-21, 6.1-22, 6.1-26

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
1,1,2-Trichloroethane	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	11[b]	4.3-34	0[b]	4.3-34
	Granular Media Filtration	1	2,100[b]	4.6-27	0[c]	4.6-27
	Activated Sludge	1	<10[e]	5.1-23	>9	5.1-23
	Steam Stripping	5	<10[d]	5.5-8, 5.5-10, 5.5-11, 5.5-12	>99	5.5-8, 5.5-10, 5.5-11, 5.5-12
	Solvent Extraction	5	5,400	5.6-9	95	5.6-9
	Granular Activated Carbon Adsorption	3	<10[d]	6.1-26	>99	6.1-26
1,1,2,2-Tetrachloroethane	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	35	4.3-27	30	4.3-27
	Granular Media Filtration	2	0.7[b]	4.6-10	0[c]	4.6-10, 4.6-11
	Activated Sludge	2	<10	5.1-27	>44	5.1-26
	Steam Stripping	5	<10[d]	5.5-11	>99	5.5-11
	Solvent Extraction	5	1,000	5.6-9	99	5.6-9
	Granular Activated Carbon Adsorption	25	20	6.1-25	>99	6.1-24, 6.1-25
Chloroethane	Granular Activated Carbon Adsorption	11	<10[d]	6.1-15, 6.1-16, 6.1-18, 6.1-21 6.1-22	>99	6.1-15, 6.1-16, 6.1-21, 6.1-22
Bis(chloromethyl) ether	Activated Sludge	1	<10[d]	5.1-71	>83	5.1-71

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Bis(2-chloroethyl) ether	Activated Sludge	1	$<10^e$	5.1-19	>47	5.1-19
	Powdered Carbon Addition (With Activated Sludge)	1	44	6.2-24	53	6.2-24
2-Chloronaphthalene	Gas Flotation with Chemical Addition (Alum, Polymer)	1	16	4.5-5	3	4.5-5
	Granular Media Filtration	1	17^b	4.6-9	0^c	4.6-9
	Activated Sludge	1	1	5.1-19	50	5.1-19
	Lagoon (Aerated)	1	$<10^e$	5.3-14	>47	5.3-14
2,4,6-Trichlorophenol	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	3^b	4.5-6	0^c	4.5-6
	Granular Media Filtration	1	69	4.6-14	80	4.6-14
	Activated Sludge	10	<0.2	5.1-53	98	5.1-24, 5.1-74
	Trickling Filters	1	2	5.2-13	0^c	5.2-13
	Lagoon (Aerated)	1	$<10^d$	5.3-12	>99	5.3-12
p-Chloro-*m*-cresol	Clarification/Sedimentation	1	$<10^d$	4.2-35	>91	4.2-35
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	62	4.3-64	44	4.3-64

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
p-Chloro-m-cresol (continued)	Granular Media Filtration	2	0.3^b	4.6-40	0^c	4.6-40, 4.6-43
	Activated Sludge	4	<0.1	5.1-52	>98	5.1-52
	Granular Activated Carbon Adsorption	1	<0.1	6.1-43	>83	6.1-43
Chloroform	Clarification/Sedimentation	1	22^b	4.2-40	0^c	4.2-40
	Clarification/Sedimentation with Chemical Addition (Alum)	1	22^b	4.3-21	0^c	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	3	$<10^d$	4.3-35	>94	4.3-35
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	2	7^b 42	4.3-64 4.3-66	>9	4.3-66
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	11^b	4.3-72	0^c	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	74^b	4.3-27	0^c	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	<3	4.4-6	>0	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	19^b	4.5-6	0^c	4.5-6
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	$0.8^{a,b}$ 8	4.5-6 4.5-7	74	4.5-8
	Gas Flotation with Chemical Addition (Polymer)	1	24	4.5-14	41	4.5-14
	Granular Media Filtration	6	7^b 12	4.6-14 4.6-11	50	4.6-11

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Chloroform (continued)	Activated Sludge	16	<1	5.1-56	>99	5.1-23, 5.1-56
	Trickling Filters	1	19	5.2-13	0[c]	5.2-13
	Lagoon (Aerated)	2	<10[d]	5.3-16	>57	5.3-16
	Steam Stripping	5	<10[d]	5.5-8, 5.5-9, 5.5-11, 5.5-12	>99	5.5-8, 5.5-9, 5.5-11, 5.5-12
	Granular Activated Carbon Adsorption	5	<5[a] <10[d]	6.1-38 6.1-26	>99	6.1-26
	Reverse Osmosis	4	4	6.9-17	79	6.9-17
2-Chlorophenol	Clarification/Sedimentation	1	<10[d]	4.2-20	>88	4.2-20
	Gas Flotation with Chemical Addition (Polymer)	1	2[b]	4.5-14	0[c]	4.5-14
	Granular Media Filtration	1	2	4.6-11	0	4.6-11
	Activated Sludge	2	0.9[b] 10	5.1-19 5.1-54	92	5.1-54
	Powdered Carbon Addition (With Activated Sludge)	1	190,000	6.2-24	81	6.2-24

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency %	Volume III page(s)
1,2-Dichlorobenzene	Gravity Oil Separation	1	$<10^d$	4.1-5	>9	4.1-5
	Clarification/Sedimentation with Chemical Addition (Alum)	2	$<10^d$	4.3-24	>50	4.3-24
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<0.05	4.3-28	>99	4.3-28
	Granular Media Filtration	3	<0.05	4.6-38	>94	4.6-38
	Activated Sludge	12	<0.05	5.1-48, 5.1-50, 5.1-52, 5.1-56, 5.1-65	>99	5.1-48, 5.1-50
	Lagoon (Aerated)	1	$<10^d$	5.3-12	>96	5.3-12
	Granular Activated Carbon Adsorption	2	<0.05	6.1-41, 6.1-44	>99	6.1-41, 6.1-44
1,4-Dichlorobenzene	Activated Sludge	8	<0.04	5.1-48, 5.1-55	>99	5.1-43, 5.1-48
	Lagoon (Aerated)	1	$<10^d$	5.3-12	>81	5.3-12
1,1-Dichloroethylene	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	$<10^d$	4.3-32	>98	4.3-32
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	$1,000^b$	4.5-12	0^c	4.5-12
	Granular Media Filtration	1	<2	4.6-43	>52	4.6-43

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
1,2-Trans-dichloroethylene	Gravity Oil Separation	1	20	4.1-17		
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	190	4.3-32	28	4.3-32
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	21^b	4.3-72	0^c	4.3-72
	Granular Media Filtration	1	47^b	4.6-27	0^c	4.6-27
	Steam Stripping	5	$<10^d$	5.5-10	>99	5.5-10
	Granular Activated Carbon Adsorption	39	20^b	6.1-24, 6.1-25	>99	6.1-24
	Ozonation	1	2.1^b	6.14-17	0^c	6.14-17
2,4-Dichlorophenol	Clarification/Sedimentation	1	48	4.2-26	98	4.2-26
	Gas Flotation with Chemical Addition (Polymer)	1	6^b	4.5-14	0^c	4.5-14
	Granular Media Filtration	2	$0.2^{a,b}$ 2	4.6-40 4.6-11	67	4.6-11
	Activated Sludge	2	$<10^e$ $<10^d$	5.1-19 5.1-71	>50	5.1-49
1,2-Dichloropropane	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	400	4.3-27	59	4.3-27
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	930^b	4.5-12	0^c	4.5-12
	Granular Media Filtration	1	1^b	4.6-38	0^c	4.6-38
	Activated Sludge	2	<0.7	5.1-48	>82	5.1-71
	Granular Activated Carbon Adsorption	3	$<0.7^{a,b}$ $<10^d$	6.1-42 6.1-26	>99	6.1-26

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
1,2-Dichloropropane (continued)	Powdered Carbon Addition (With Activated Sludge)	1	70,000	6.2-24	93	6.2-24
1,3-Dichloropropane	Activated Sludge	1	0.89[b]	5.1-65	0[c]	5.1-65
2,4-Dimethylphenol	Gravity Oil Separation[h]	4	71	4.1-28		
	Clarification/Sedimentation	1	<10[d]	4.2-20	>55	4.2-20
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	<10[e]	4.3-64	>76	4.3-64
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	<0.1	4.5-6	>99	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	28[b]	4.5-14	0[c]	4.5-14
	Granular Media Filtration	3	0.4[b]	4.6-40	0[c]	4.6-11, 4.6-40, 4.6-41
	Activated Sludge	3	8[b] <10[d]	5.1-58 5.1-71	>95	5.1-71
	Granular Activated Carbon Adsorption	1	<0.1	6.1-41	>89	6.1-41
2,4-Dinitrotoluene	Clarification/Sedimentation	1	10	4.2-30	80	4.2-30
	Lagoon (Aerated)	1	3	5.3-14	0[c]	5.3-14
2,6-Dinitrotoluene	Clarification/Sedimentation	1	10	4.2-30	80	4.2-30
	Activated Sludge	1	390[b]	5.1-19	0[c]	5.1-19
	Lagoon (Aerated)	1	2	5.3-14	83	5.3-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
1,2-Diphenylhydrazine	Activated Sludge	1	340[b]	5.1-19	0[c]	5.1-19
	Lagoon (Aerated)	1	14	5.3-14	0[c]	5.3-14
Ethylbenzene	Gravity Oil Separation[h]	1	<100	4.1-17		
	Clarification/Sedimentation	2	3[a] 2,400	4.2-64 4.2-31	64	4.2-31
	Clarification/Sedimentation with Chemical Addition (Alum)	2	1.3[b]	4.3-25	0[c]	4.3-21, 4.3-25
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	3	<10[d]	4.3-33	>94	4.3-33
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	130	4.3-72	81	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	2	<0.2	4.3-28	>96	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	<10[d]	4.4-6	>99	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	3[b]	4.5-5	0[c]	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride Polymer)	4	<10[d]	4.5-9	>99	4.5-9
	Gas Flotation with Chemical Addition (Polymer)	1	160	4.5-15	65	4.5-15
	Granular Media Filtration	6	<0.2	4.6-38 4.6-42 4.6-45	>99	4.6-28

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Ethylbenzene (continued)	Activated Sludge	24	<0.2	5.1-46, 5.1-47, 5.1-50, 5.1-52, 5.1-54, 5.1-55, 5.1-56, 5.1-64, 5.1-66, 5.1-67 5.1-68, 5.1-69	>99	5.1-46, 5.1-47, 5.1-50, 5.1-54, 5.1-56, 5.1-64, 5.1-67, 5.1-74,
	Lagoon (Aerated)	2	<10[d]	5.3-12, 5.3-20,	>94	5.3-20
	Solvent Extraction	1	4,000	5.6-14	97	5.6-14
	Granular Activated Carbon Adsorption	1	<0.2	6.1-43	>0	6.1-43
	Powdered Carbon Addition (With Activated Sludge)	1	18,000	6.2-24	84	6.2-24
Fluoranthene	Gravity Oil Separation[h]	3	7.5	4.1-28		
	Clarification/Sedimentation	3	0.4	4.2-64	64	4.2-64
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	<10[e]	4.3-64	>97	4.3-64
	Gas Flotation with Chemical Addition (Polymer)	1	0.5[b]	4.5-14	0[c]	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	≤10[b]	4.5-12	0[c]	4.5-12
	Granular Media Filtration	4	0.05	4.6-21	50	4.6-42
	Activated Sludge	1	2	5.1-19	0	5.1-19
	Lagoon (Aerated)	1	<10[d]	5.3-14	>0	5.3-14
	Granular Activated Carbon Adsorption	2	<0.02	6.1-42 6.1-49	>90	6.1-49

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Fluoranthene (continued)	Ozonation	1	0.1	6.14-16	50	6.14-16
4-Bromophenyl phenyl ether	Activated Sludge	1	18	5.1-19	95	5.1-19
Bis(2-chloroisopropyl) ether	Lagoon (Aerated)	1	$<10^e$	5.3-14	>0	5.3-14
Bis(2-chloroethoxy)methane	Lagoon (Aerated)	1	$<10^e$	5.3-14	>60	5.3-14
Methylene chloride	Gravity Oil Separation[h]	5	10	4.1-26		
	Clarification/Sedimentation	5	1.5	4.2-47	>99	4.2-47
	Clarification/Sedimentation with Chemical Addition (Alum)	2	$<10^d$	4.3-21	>88	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	110	4.3-35 4.3-17	98	4.3-35
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	2	13^b	4.3-67	0^c	4.3-64, 4.3-67
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	2.5^b	4.3-73	0^c	4.3-72, 4.3-73
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	2,000	4.3-27	13	4.3-27
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	8	4.5-5	84	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	2	4.5-6	7	4.5-7
	Gas Flotation with Chemical Addition (Polymer)	1	22	4.5-14	61	4.5-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Methylene chloride (continued)	Granular Media Filtration	15	<0.4	4.6-10	>87	4.6-10
	Activated Sludge	5	0.9[a] 5	5.1-37 5.1-35	99	5.1-35
	Trickling Filters	1	1	5.2-13	0[c]	5.2-13
	Lagoon (Aerated)	3	32	5.3-18	97	5.3-18
	Steam Stripping	5	90,000	5.5-8	87	5.5-8
	Granular Activated Carbon Adsorption	46	1.8 60	6.1-49 6.1-25	99	6.1-25
	Reverse Osmosis	4	4	6.9-17	64	6.9-18
	Ozonation	2	15[b]	6.14-17	0[c]	6.14-16, 6.14-17
Methyl chloride	Clarification/Sedimentation	1	3	4.2-45	84	4.2-45
	Gas Flotation with Chemical Addition (Polymer)	1	30[b]	4.5-15	0[c]	4.5-15
	Lagoon (Aerated)	1	<5	5.3-20	>91	5.3-20
	Reverse Osmosis	1	45[b]	6.9-21	0[c]	6.9-21
Bromoform	Activated Sludge	1	3[b]	5.1-36	0[c]	5.1-36

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Dichlorobromomethane	Gas Flotation with Chemical Addition (Alum, Polymer)	1	<0.9	4.5-5	>85	4.5-6
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	290^b	4.5-12	0^c	4.5-12
	Activated Sludge	2	15^a $<9^d$	5.1-65 5.1-35	>0	5.1-35, 5.1-65
Trichlorofluoromethane	Gas Flotation with Chemical Addition (Alum, Polymer)	1	<2	4.5-5	>50	4.5-6
	Granular Media Filtration	2	5^b	4.6-11	0^c	4.6-9, 4.6-11
	Activated Sludge	5	1.7	5.1-48	96	5.1-48
	Lagoon (Tertiary)	1	$<10^d$	5.3-26	>79	5.3-26
	Granular Activated Carbon Adsorption	1	69^b	6.1-38	0^c	6.1-38
Chlorodibromomethane	Clarification/Sedimentation	1	$<10^d$	4.2-31	>77	4.2-31
	Clarification/Sedimentation with Chemical Addition (Alum)	1	<0.3	4.3-25	>50	4.3-25
Isophorone	Clarification/Sedimentation	2	$<10^d$	4.2-20	>97	4.2-20
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	$<10^d$	4.5-7	>95	4.5-7
	Activated Sludge	2	<10	5.1-19	>0	5.1-19, 5.1-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Isophorone (continued)	Lagoon (Aerated)	1	2	5.3-14	33	5.3-14
	Powdered Carbon Addition (With Activated Sludge)	1	30,000	6 2-24	97	6.2-24
Naphthalene	Gravity Oil Separation[h]	10	50	4.1-20		
	Clarification/Sedimentation	2	<10[d]	4.2-20	>98	4.2-20
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	3	4.3-64	98	4.3-64
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	16	4.3-27	70	4.3-27
	Gas Flotation (Dissolved Air Flotation)	2	60	4,4-6	36	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	11	4.5-5	52	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	480	4.5-8	82	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	2	0.6[a] <10[d]	4.5-14 4.5-15	>96	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	96	4.5-12	77	4.5-12
	Granular Media Filtration	3	0.9[b] <10[d]	4.6-11 4.6-27	86	4.6-9
	Activated Sludge	26	<0.007	5.1-43, 5.1-44, 5.1-46, 5.1-47, 5.1-49, 5.1-51, 5.1-52, 5.1-56, 5.1-57, 5.1-58, 5.1-61	>99	5.1-44, 5.1-47, 5.1-49, 5.1-51, 5.1-52, 5.1-56, 5.1-57, 5.1-58, 5.1-61, 5.1-67, 5.1-70, 5.1-74

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Naphthalene (continued)	Trickling Filters	1	55	5.2-13	0[c]	5.2-13
	Lagoon (Aerated)	2	<10[d] <10[e]	5.3-15 5.3-66	>58	5.3-15
	Lagoon (Tertiary)	1	<10[d]	5.3-25	>82	5.3-25
	Powdered Carbon Addition (With Activated Sludge)	1	<10[e]	6.2-13	>96	6.2-13
Nitrobenzene	Clarification/Sedimentation	1	<10[d]	4.2-20	>52	4.2-20
	Clarification/Sedimentation with Chemical Addition (Alum)	1	35	4.3-21	68	4.3-21
	Lagoon (Aerated)	1	<10[e]	5.3-14	>0	5.3-14
2-Nitrophenol	Clarification/Sedimentation	1	<10[d]	4.2-25	>47	4.2-25
	Activated Sludge	1	<0.4	5.1-52	>99	5.1-52
4-Nitrophenol	Activated Sludge	1	<0.9	5.1-52	>99	5.1-52
	Lagoon (Aerated)	1	<10	5.3-20	>23	5.3-20

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
4,6-Dinitro-*o*-cresol	Clarification/Sedimentation	1	<10[d]	4.2-20	>47	4.2-20
N-nitrosodiphenylamine	Clarification/Sedimentation	1	<10[d]	4.2-20	>77	4.2-20
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	620	4.5-7	66	4.5-7
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	84[b]	4.5-12	0[c]	4.5-12
	Granular Media Filtration	1	0.4[b]	4.6-41	0[c]	4.6-41
	Activated Sludge	2	<0.07	5.1-64	>99	5.1-64
	Lagoon (Aerated)	1	1	5.3-14	67	5.3-14
	Granular Activated Carbon Adsorption	1	<0.07	6.1-41	>82	6.1-41
N-nitroso-di-n-propylamine	Activated Sludge	2	2[b]	5.1-44	0[c]	5.1-44, 5.1-61
Pentachlorophenol	Gravity Oil Separation[h]	2	120	4.1-33		
	Clarification/Sedimentation	1	24	4.2-26	55	4.2-26
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	27[b]	4.5-6	0[c]	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	2	8[a,b] 30	4.5-14 4.5-15	19	4.5-15

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Pentachlorophenol (continued)	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	13^b	4.5-12	0^c	4.5-12
	Granular Media Filtration	4	<0.4	4.6-10	>87	4.6-10
	Activated Sludge	15	<0.4	5.1-43, 5.1-46, 5.1-47, 5.1-48, 5.1-53, 5.1-54, 5.1-57, 5.1-65	>99	5.1-43, 5.1-47
	Trickling Filters	1	3	5.2-13	0^c	5.2-13
	Lagoon (Aerated)	1	$<10^d$	5.3-20	>71	5.3-20
	Granular Activated Carbon Adsorption	4	<0.4	6.1-41, 6.1-44	>97	6.1-44
Phenol	Gravity Oil Separation[h]	12	6	4.1-30		
	Clarification/Sedimentation	1	33	4.2-26	>99	4.2-26
	Clarification/Sedimentation with Chemical Addition (Alum)	2	<0.07	4.3-25	>90	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	2	4.3-25	89	4.3-31
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	$<10^e$	4.3-64	>37	4.3-64
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	0.5	4.3-73	29	4.3-73
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	2	3^b 47	4.3-28 4.3-21	96	4.3-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Phenol (continued)	Gas Flotation (Dissolved Air Flotation)	2	5^{b}	4.4-6	0^{c}	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	28^{b}	4.5-5	0^{c}	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	42	4.5-6	80	4.5-7
	Gas Flotation with Chemical Addition (Polymer)	2	9^{a,b} 26	4.5-14 4.5-15	72	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	190^{b}	4.5-12	0^{c}	4.5-12
	Granular Media Filtration	10	<0.07	4.6-10	>93	4.6-10
	Activated Sludge	30	<0.07	5.1-43, 5.1-45, 5.1-47, 5.1-48, 5.1-50,, 5.1-52, 5.1-56, 5.1-57, 5.1-58, 5.1-59, 5.1-61, 5.1-65, 5.1-66, 5.1-67, 5.1-69, 5.1-70	>99	5.1-24, 5.1-47, 5.1-48, 5.1-50, 5.1-52, 5.1-56, 5.1-57, 5.1-58, 5.1-59, 5.1-61, 5.1-66, 5.1-69, 5.1-70, 5.1-74
	Trickling Filters	1	37	5.2-13	0^{c}	5.2-13
	Lagoon (Aerated)	3	<10^{b}	5.3-12	>99	5.3-12
	Solvent Extraction	15	<1,000	5.6-19	>99	5.6-19
	Granular Activated Carbon Adsorption	5	<0.07	6.1-38, 6.1-39	>96	6.1-39

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency %	Volume III page(s)
Phenol (continued)	Powdered Carbon Addition (With Activated Sludge)	2	<10[e]	6.2-13	>85	6.2-13
	Reverse Osmosis	4	0.2	6.9-18	80	6.9-18
Bis(2-ethylhexyl) phthalate	Gravity Oil Separation[h]	9	9.5	4.1-33		
	Clarification/Sedimentation	9	0 02	4.2-57	80	4.2-57
	Clarification/Sedimentation with Chemical Addition (Alum)	2	33[b]	4.3-65	0[c]	4.3-24, 4.3-25
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	2	32	4.3-64	97	4.3-64
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	2.4	4.3-37	95	4.3-37
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	<10	4.3-72	>97	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	44[b]	4.3-28	0[c]	4.3-28
	Gas Flotation (Dissolved Air Flotation)	2	30[b]	4.4-6	0[c]	4.4-5, 4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	90	4.5-5	25	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	2	220	4.5-6	82	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	2	45	4.5-15	92	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	110	4.5-12	98	4.5-12
	Granular Media Filtration	14	3.3	4.6-36	98	4.6-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Bis(2-ethylhexyl) phthalate (continued)	Activated Sludge	38	<0.04	5.1-57	>99	5.1-57
	Trickling Filters	1	6	5.2-13	83	5.2-13
	Lagoon (Aerated)	5	1	5.3-26	96	5.3-12
	Lagoon (Tertiary)	2	$<10^{a,d}$ 11	5.3-25, 5.3-26	72	5.3-26
	Granular Activated Carbon Adsorption	9	3.9	6.1-39	66	6.1-7
	Powdered Carbon Addition (With Activated Sludge)	1	$<10^{e}$	6.2-13	>97	6.2-13
	Reverse Osmosis	5	2	6.9-18	96	6.9-18
	Ozonation	2	90^{b}	6.14-17	0^{c}	6.14-16, 6.14-17
Butyl benzyl phthalate	Clarification/Sedimentation	1	4	4.2-26	>96	4.2-26
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	$<10^{e}$	4.3-56	>99	4.3-56
	Gas Flotation (Dissolved Air Flotation)	1	$<10^{c}$	4.4-6	>99	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	81^{b}	4.5-5	0^{c}	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	<0.03	4.5-6	>99	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	<0.03	4.5-14	>99	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	42	4.5-12	97	4.5-12
	Granular Media Filtration	4	<0.03	4.6-9	>99	4.6-9

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Butyl benzyl phthalate (continued)	Activated Sludge	1	11[b]	5.1-36	0[c]	5.1-36
	Lagoon (Aerated)	1	6	5.3-14	0	5.3-14
	Granular Activated Carbon Adsorption	3	<0.03	6.1-43, 6.1-45	>99	6.1-43, 6.1-45
	Ozonation	1	<0.03	6.14-17	>97	6.14-17
Di-n-butyl phthalate	Gravity Oil Separation[h]	1	1.3	4.1-17		
	Clarification/Sedimentation	5	<10[e]	4.2-35, 4.2-26	83	4.2-26
	Clarification/Sedimentation with Chemical Addition (Alum)	2	0.6	4.3-25	>94	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	<10	4.3-32	>99	4.3-32
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	1	4.3-64	99	4.3-64
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	2.8[b] <10	4.3-73 4.3-25	>99	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<10[d]	4.3-27	>99	4.3-27
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	300	4.5-5	0	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	2	19	4.5-6	79	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	2	<0.02	4.5-14	>99	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	21	4.5-12	97	4.5-12

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Di-n-butyl phthalate (continued)	Granular Media Filtration	12	<0.02	4.6-40	>99	4.6-40
	Activated Sludge	9	<0.02	5.1-46, 5.1-52, 5.1-60, 5.1-61	>99	5.1-46, 5.1-52, 5.1-60, 5.1-61
	Trickling Filters	1	6	5.2-13	25	5.2-13
	Lagoon (Aerated)	1	1	5.3-14	0	5.3-14
	Granular Activated Carbon Adsorption	7	<0.02	6.1-38, 6.1-39, 6.1-45	>99	6.1-38, 6.1-39, 6.1-45
	Reverse Osmosis	3	0.8[a] 1.2[b]	6.9-20, 6.9-21 6.9-21	83	6.9-18
	Ozonation	2	2.7	6.14-16, 6.14-17	77	6.14-17
Di-n-octyl phthalate	Clarification/Sedimentation	1	<10[e]	4.2-35	>50	4.2-35
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	21[b]	4.5-5	0[c]	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	33	4.5-6	78	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	11	4.5-14	61	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	<10[d]	4.5-12	>98	4.5-12
	Granular Media Filtration	3	<0.9	4.6-9	>96	4.6-9

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Di-n-octyl phthalate (continued)	Activated Sludge	1	5,000[b]	5.1-23	0[c]	5.1-23
	Granular Activated Carbon Adsorption	5	4[a] 48	6.1-7 6.1-11	96	6.1-11
Diethyl phthalate	Gravity Oil Separation[h]	1	12	4.1-17		
	Clarification/Sedimentation	1	22[b]	4.2-26	0[c]	4.2-26
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer	1	<10[e]	4.3-64	>99	4.3-64
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	<0.03	4.3-73	>98	4.3-73
	Gas Flotation (Dissolved Air Flotation)	1	10[d]	4.4-6	>17	4.4-6
	Granular Media Filtration	5	<0.03	4.6-10	>99	4.6-10
	Activated Sludge	17	<0.03	5.1-43, 5.1-44, 5.1-45, 5.1-48, 5.1-49, 5.1-53, 5.1-54, 5.1-61, 5.1-65	>99	5.1-44, 5.1-45, 5.1-48, 5.1-49, 5.1-54, 5.1-65
	Trickling Filters	1	140	5.2-13	0[c]	5.2-13
	Lagoon (Aerated)	1	4	5.3-14	0[c]	5.3-14
	Granular Activated Carbon Adsorption	3	1.2[b]	6.1-42	0[c]	6.1-42
Dimethyl phthalate	Clarification/Sedimentation	2	55	4.2-26	98	4.2-26
	Granular Media Filtration	1	<0.03	4.6-38	>98	4 6-38

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Dimethyl phthalate (continued)	Activated Sludge	9	<0.03	5.1-43, 5.1-54, 5.1-55, 5.1-61, 5.1-66	>99	5.1-43, 5.1-54, 5.1-55, 5.1-61, 5.1-66
	Lagoon (Aerated)	1	6	5.3-14	25	5.3-14
	Reverse Osmosis	2	45^d 170	6.9-21 6.9-18	41	6.9-18
Benz(a)anthracene	Gravity Oil Separation[h]	1	55	4.1-33		
Benzo(a)pyrene	Gravity Oil Separation[h]	2	5.5	4.1-33		
	Clarification/Sedimentation	3	<0.02	4.2-64	>98	4.2-64
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	10^c	4.3-64	>81	4.3-64
	Granular Media Filtration	2	0.2^b	4.6-42	0^c	4.6-42
	Lagoon (Aerated)	1	2	5.3-14	33	5.3-14
	Granular Activated Carbon Adsorption	2	<0.02	6.1-41, 6.1-49	>97	6.1-41
	Ozonation	1	<0.02	6.14-16	>90	6.14-16

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Benzo(b)fluoranthene	Clarification/Sedimentation	1	6	4.2-26	83	4.2-26
	Lagoon (Aerated)	1	0.4	5.3-14	97	5.3-14
Benzo(k)fluoranthene	Gravity Oil Separation[h]	2	37	4.1-33		
	Clarification/Sedimentation	2	<0.02	4.2-64	>97	4.2-64
	Granular Media Filtration	1	0.1[b]	4.6-42	0[c]	4.6-42
	Granular Activated Carbon Adsorption	1	<0.02	6.1-49	>80	6.1-49
	Ozonation	1	<0.02	6.14-16	>80	6.14-16
Chrysene	Gravity Oil Separation[h]	2	1.7	4.1-26		
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	10	4.3-64	99	4.3-64
Acenaphthylene	Gravity Oil Separation[h]	3	4	4.1-17		
	Clarification/Sedimentation	1	<10[d]	4.2-20	>17	4.2-20
	Lagoon (Aerated)	1	5	5.3-14	0[c]	5.3-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Anthracene/phenanthrene	Gravity Oil Separation[h]	8	4.6	4.1-17		
	Clarification/Sedimentation	4	0.4	4.2-64	92	4.2-26
	Clarification/Sedimentation with Chemical Addition (Alum)	1	0.1[b]	4.3-65	0[c]	4.3-65
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	<10[e]	4.3-64	>0	4.3-64
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	0.9[b]	4.3-73	0[c]	4.3-73
	Gas Flotation (Dissolved Air Flotation)	1	2,600	4.4-5	45	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	10[b]	4.5-5	0[c]	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	66	4.5-6	83	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	2[b]	4.5-14	0[c]	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	≤10	4.5-12	≥8	4.5-12
	Granular Media Filtration	9	0.03	4.6-45	70	4.6-45
	Activated Sludge	7	<0.01	5.1-44	>98	5.1-56
	Lagoon (Aerated)	1	3	5.3-14	0[c]	5.3-14
	Granular Activated Carbon Adsorption	5	<0.01	6.1-45	>97	6.1-45
	Reverse Osmosis	1	0.7	6.9-18	77	6.9-18
	Ozonation	2	<0.01	6.14-17	>97	6.14-17

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency %	Volume III page(s)
Benzo(ghi)perylene	Gravity Oil Separation	2	2	4.1-33		
	Clarification/Sedimentation	1	$<10^d$	4.2-20	>17	4.2-20
Fluorene	Gravity Oil Separation^h	3	34	4.1-33		
	Clarification/Sedimentation	1	$<10^d$	4.2-20	>79	4.2-20
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	$<10^d$	4.3-64	>99	4.3-64
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	14^b	4.5-12	0^c	4.5-12
	Granular Media Filtration	1	$10,000^b$	4.6-14	0^c	4.6-14
	Activated Sludge	2	<0.02	5.1-19, 5.1-48	>99	5.1-19, 5.1-48
	Lagoon (Aerated)	1	0.2	5.3-14	99	5.3-14
Indeno(1,2,3-cd)pyrene	Gravity Oil Separation^h	1	40	4.1-33		
	Activated Sludge	1	<0.02	5.1-68	>99	5.1-68
Pyrene	Gravity Oil Separation^h	3	7	4.1-26		
	Clarification/Sedimentation	3	0.2	4.2-64	79	4.2-64
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	$<10^e$	4.3-64	>87	4.3-64

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Pyrene (continued)	Gas Flotation with Chemical Addition (Polymer)	1	0.3	4.5-14	0	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	18^b	4.5-12	0^c	4.5-12
	Granular Media Filtration	3	0.1	4.6-38	0	4.6-38
	Activated Sludge	5	0.1^b 0.2	5.1-47, 5.1-49 5.1-54	78	5.1-54
	Lagoon (Aerated)	1	1	5.3-14	67	5.3-14
	Granular Activated Carbon Adsorption	2	<0.01	6.1-42, 6.1-49	>97	6.1-49
	Reverse Osmosis	1	18	6.9-20	0	6.9-20
	Ozonation	1	0.1	6.14-16	67	6.14-16
Tetrachloroethylene	Gravity Oil Separation[h]	2	$<50,^h$ 71^b	4.1-17, 4.1-5	13	4.1-5
	Clarification/Sedimentation	3	1.1	4.2-45	76	4.2-45
	Clarification/Sedimentation with Chemical Addition (Alum)	1	45^b	4.3-21	0^c	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	3	$<10^d$	4.3-35	>44	4.3-35
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	13	4.3-27	95	4.3-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Tetrachloroethylene (continued)	Gas Flotation with Chemical Addition (Alum, Polymer)	1	<0.9	4.5-5	>10	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	4	5	4.5-8	0^a	4.5-9, 4.5-7, 4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	2	4.5-14	0	4.5-14
	Granular Media Filtration	7	1^b 17	4.6-9 4.6-39	>99	4.6-27
	Activated Sludge	11	<0.1	5.1-37	>99	5.1-50, 5.1-56
	Lagoon (Aerated)	1	$<10^d$	5.3-16	>60	5.3-16
	Steam Stripping	3	$<10^d$ 0.6^b	5.5-8, 5.5-10	>99	5.5-8, 5.5-10
	Granular Activated Carbon Adsorption	1	32	6.1-7	68	6.1-7

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration µg/L	Volume III page(s)	Highest observed removal efficiency %	Volume III page(s)
Toluene	Gravity Oil Separation[h]	4	23	4.1-33		
	Clarification/Sedimentation	4	9.5[b] <10	4.2-64 4.2-25	69	4.2-36
	Clarification/Sedimentation with Chemical Addition (Alum)	3	1	4.3-65	93	4.3-65
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	3	4.3-31	73	4.3-35
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	0.4[a] 1,900	4.3-73 4.3-72	39	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	2	14[a] 72	4.3-28 4.3-27	96	4.3-27
	Gas Flotation (Dissolved Air Flotation)	1	<10[d]	4.4-6	92	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	4.5	4.5-5	10	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	4	380[a,b] 900	4.5-6 4.5-9	65	4.5-9
	Gas Flotation with Chemical Addition (Polymer)	1	130	4.5-15	59	4.5-15
	Granular Media Filtration	14	<0.1	4.6-42, 4.6-45	>99	4.6-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Toluene (continued)	Activated Sludge	31	<0.1	5.1-37, 5.1-44, 5.1-54, 5.1-55	>99	5.1-37, 5.1-54, 5.1-70
	Lagoon (Aerated)	3	<10[d]	5.3-16, 5.3-20,	>95	5.3-16, 5.3-20
	Solvent Extraction	2	1,600	5.6-12	96	5.6-12
	Granular Activated Carbon Adsorption	8	<0.1	6.1-41, 6.1-42	>99	6.1-41
	Powdered Carbon Addition (With Activated Sludge)	1	67,000	6.2-24	79	6.2-24
	Reverse Osmosis	6	0.7	6.9-19	12	6.9-19
	Ozonation	1	0.9	6.14-17	31	6.14-17
Trichloroethylene	Gravity Oil Separation[h]	1	>>100	4.1-17		
	Clarification/Sedimentation	1	56[b]	4.2-22	0[c]	4.2-22
	Clarification/Sedimentation with Chemical Addition (Alum)	1	190	4.3-21	10	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	12[b]	4.3-31	0[c]	4.3-31
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	0.8[b]	4.3-73	0[c]	4.3-72, 4.3-73
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	2	6[a,b] 30	4.5-6 4.5-7	86	4.5-7
	Granular Media Filtration	6	<0.5	4.6-36	>90	4.6-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Trichloroethylene (continued)	Activated Sludge	12	<0.5	5.1-45 5.1-47, 5.1-54, 5.1-56, 5.1-58, 5.1-60, 5.1-69	>99	5.1-54, 5.1-56, 5.1-60, 5.1-62
	Trickling Filters	1	1	5.2-13	0[c]	5.2-13
	Steam Stripping	5	<10[d]	5.5-8, 5.5-10	>99	5.5-8, 5.5-10
	Granular Activated Carbon Adsorption	2	0.6[b] 5	6.1-45 6.1-7	58	6.1-7
	Reverse Osmosis	1	0.4	6.9-16	60	6.9-16
	Ozonation	1	0.9[b]	6.14-17	0[c]	6.14-17
Vinyl chloride	Granular Activated Carbon Adsorption	3	1,100	6.1-26	52	6.1-26
Chlordane	Granular Media Filtration	1	24	4.6-14	37	4.6-14
4,4'-DDT	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<1	4.3-28	>52	4.3-28
Heptachlor	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<1	4.3-28	>29	4.3-28
	Activated Sludge	1	1.5	5.1-43	76	5.1-43
α-BHC	Granular Media Filtration	2	1.9[b] 6	4.6-41 4.6-14	77	4.6-14
	Granular Activated Carbon Adsorption	1	<1.0	6.1-41	>47	6.1-41

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
β-BHC	Granular Media Filtration	1	55	4.6-14	21	4.6-14
Total aroclors; 1016, 1221, 1232, 1242, 1248, 1260	Gravity Oil Separation	15	0.1[h]	4.1-19, 4.1-26 4.1-28		
	Gas Flotation (Dissolved Air Flotation)	2	0.5[b]	4.4-5	0[c]	4.4-5
	Granular Media Filtration	1	480	4.6-14	16	4.6-14
Antimony	Gravity Oil Separation	5	1[h] 290[b]	4.1,20, 4.1-33 4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	12	2	4.2-14	86	4.2-60
	Clarification/Sedimentation with Chemical Addition (Alum)	2	23	4.3-24	0[c]	4.3-24, 4.3-65
	Clarification/Sedimentation with Chemical Addition (Lime)	7	1.9	4.3-47	83	4.3-56
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	1	<50	4.3-37	>0	4.3-37
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	43	4.3-73	44	4.3-73
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	4	3.5	4.3-40, 4.3-41 4.3-45	30	4.3-40, 4.3-41 4.3-43, 4.3-45
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	2,200	4.5-5	6	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	5	<10	4.5-6	>89	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	64[b]	4.5-14	0[c]	4.5-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Antimony (continued)	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	18	4.5-12	81	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	3	4.5-13	62	4.5-13
	Granular Media Filtration	15	<10	4.6-11, 4.6-10	89	4.6-17
	Activated Sludge	18	0.3	5.1-48	90	5.1-47
	Lagoon (Aerated)	1	30	5.3-16	82	5.3-16
	Granular Activated Carbon Adsorption	8	24^a 36	6.1-39, 6.1-41 6.1-45	33	6.1-43
	Powdered Carbon Addition (With Activated Sludge)	2	41	6.2-10	5	6.2-10
	Reverse Osmosis	11	2	6.9-13	60	6.9-13
	Ozonation	2	25^b	6.14-17	0^c	6.14-16, 6.14-17
Arsenic	Gravity Oil Separation	12	3^h	4.1-20, 4.1-22 4.1-23		
	Clarification/Sedimentation	24	31 <2	4.1-5 4.2-19, 4.2-45, 4.2-53, 4.2-54	0^c >99	4.1-5 4.2-16, 4.2-17, 4.2-45, 4.2-47, 4.2-48, 4.2-53, 4.2-54
	Clarification/Sedimentation with Chemical Addition (Alum)	2	<1	4.3-65	>37	4.3-65
	Clarification/Sedimentation with Chemical Addition (Lime)	11	<1	4.3-57, 4.3-60	>99	4.3-60
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	2	<10	4.3-66	>0	4.3-73

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Arsenic (continued)	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	<2	4.3-37	>33	4.3-37
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	62[b]	4.3-28	0[c]	4.3-28
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	1	<1	4.3-45	>99	4.3-45
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	3.5	4.5-5	56	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	4	2	4.5-6	80	4.5-6
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	11	4.5-12	65	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	9[b]	4.5-13	0[c]	4.5-13
	Granular Media Filtration	8	<1	4.6-44	>99	4.6-17
	Activated Sludge	8	<5	5.1-53 5.1-54, 5.1-63	>96	5.1-54
	Granular Activated Carbon Adsorption	7	<1	6.1-41	>99	6.1-41
	Reverse Osmosis	10	<1	6.9-10, 6.9-12, 6.9-17, 6.9-20	>99	6.9-12
	Ozonation	2	4[a] 43	6.14-17 6.14-16	48	6.14-16

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Asbestos[f]	Granular Media Filtration	8	8×10^4	4.6-46	>99	4.6-43, 4.6-46, 4.6-52, 4.6-55, 4.6-56
	Clarification/Sedimentation with Chemical Addition (Lime)	1	6.1×10^6	4.3-52	95	4.3-52
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)		8.2×10^6	4.3-61	>99	4.3-61
	Clariciation/Sedimentation with Chemical Addition ($BaCl_2$)	2	5.7×10^8	4.3-65	75	4.3-65
Asbestos (chrysotile)[f]	Clarification/Sedimentation	16	3.3×10^5	4.2-65	>99	4.2-55, 4,2-56, 4.2-57, 4.2-59 4.2-60, 4.2-61, 4.2-62, 4.2-64, 4.2-65, 4.2-67
	Granular Media Filtration	3	1×10^5	4.6-53	>99	4.6-51, 4.6-53, 4.6-54
	Clarification/Sedimentation	16	4.6×10^6	4.2-46	>99	4.2-45, 4.2-46, 4.2-47, 4.2-50, 4.2-51, 4.2-52, 4.2-53
Beryllium	Gravity Oil Separation	1	2[h]	4.1-21		
	Clarification/Sedimentation	7	<1	4.2-19	>98	4.2-19
	Clarification/Sedimentation with Chemical Addition (Alum)	1	2.2[b]	4.3-65	0[c]	4.3-65
	Clarification/Sedimentation with Chemical Addition (Lime)	2	0.8	4.3-61	76	4.3-61
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	2	<0.5	4.3-4	>85	4.3-44

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Beryllium (continued)	Granular Media Filtration	4	$1.2^{a,b}$	4.6-44	71	4.6-28
	Lagoon (Aerated)	1	<1	5.3-16	>50	5.3-16
	Granular Activated Carbon Adsorption	3	2	6.1-30	0	6.1-32, 6.1-33
	Reverse Osmosis	2	<0.5	6.9-11	>85	6.9-11
Cadmium	Gravity Oil Separation	3	1^{h} 200^{b}	4.1-33 4.1-5	0^{c}	4.1-5
	Clarification/Sedimentation	15	2^{a} <5	4.2-21 4.2-45, 4.2-54, 4.2-53, 4.2-48, 4.2-63	>99	4.2-45, 4.2-51, 4.2-54
	Clarification/Sedimentation with Chemical Addition (Alum)	2	2.9	4.3-25	>88	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	2	12	4.3-32	76	4.3-32
	Clarification/Sedimentation with Chemical Addition (Lime)	9	<0.5	4.3-50	92	4.3-50
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	3	15	4.3-71	93	4.3-71
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	$<10^{d}$	4.3-74	>0	4.3-74
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	100^{b}	4.3-72	0^{c}	4.3-72
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	4	<0.5	4.3-43	>50	4.3-43
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	40	4.5-5	0	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	6	<2	4.5-6, 4.5-8, 4.5-10, 4.5-11	>98	4.5-6

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Cadmium (continued)	Gas Flotation with Chemical Addition (Polymer)	1	5^b	4.5-14	0^c	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, lime, Polymer)	1	≤15	4.5-12	≥84	4.5-12
	Granular Media Filtration	19	<1	4.6-29, 4.6-31, 4.6-32	>99	4.6-17
	Ultrafiltration	3	<5	4.7-13	>93	4.7-15
	Activated Sludge	17	<0.5	5.1-44, 5.1-53, 5.1-58, 5.1-66	>99	5.1-58
	Lagoon (Aerated)	1	<2	5.3-16	>97	5.3-16
	Granular Activated Carbon Adsorption	5	5.2	6.1-41	95	6.1-41
	Powdered Carbon Addition (With Activated Sludge)	1	10^b	6.2-9	0^c	6.2-9
	Ion Exchange	1	$<10^e$	6.7-10	>99	6.7-10, 6.7-11
	Reverse Osmosis	11	<0.5	6.9-11	50	6.9-18
	Ozonation	1	250^b	6.14-16	0^c	6.14-16
Chromium	Gravity Oil Separation	24	1^h 240^b	4.1-30 4.1-5	0^c	4.1-5
	Clarification/Sedimentation	23	6^a <10	4.2-21, 4.2-52, 4.2-53	>99	4.2-36, 4.2-47, 4.2-48, 4.2-58,

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Chromium	Clarification/Sedimentation with Chemical Addition (Alum)	4	17[b] <40	4.3-25 4.3-21	>98	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	34	4.3-31	95	4.3-32
	Clarification/Sedimentation with Chemical Addition (Lime)	11	<2[a] 4	4.3-57 4.3-58	97	4.3-51
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	3	32	4.3-69	90	4.3-67
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	25	4.3-37	93	4.3-38
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	50	4.3-74	>95	4.3-74
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	<4	4.3-73	97	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	31	4.3-28	72	4.3-28
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)		<2	4.3-43, 4.3-44	>95	4.3-43, 4.3-44
	Gas Flotation (Dissolved Air Flotation)	2	2	4.4-6	87	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	360	4.5-5	19	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	6	100	4.5-10	67	4.5-10
	Gas Flotation with Chemical Addition (Polymer)	1	28[b]	4.5-14	0[c]	4.5-14

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Chromium (continued)	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	≤27	4.5-10	≥93	4.5-10
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	58	4.5-13	59	4.5-13
	Granular Media Filtration	21	<4	4.6-37	>99	4.6-13, 4.6-16
	Ultrafiltration	1	2,900	4.7-15	67	4.7-15
	Activated Sludge	34	<0.2	5.1-52, 5.1-61, 5.1-63	99	5.1-25
	Trickling Filters	1	17[b]	5.2-13	0[c]	5.2-13
	Lagoon (Aerated)	3	9	5.3-16	99	5.3-12
	Lagoon (Tertiary)	1	<10[d]	5.3-25	>71	5.3-25
	Granular Activated Carbon Adsorption	11	5.2	6.1-42	95	6.1-42
	Powdered Carbon Addition (With Activated Sludge)	4	24[a] 46	6.2-6 6.2-9	97	6.2-8
	Ion Exchange	1	10	6.7-11	>99	6.7-11
	Reverse Osmosis	13	<1	6.9-14	>99	6.9-29
	Ozonation	1	6.3[b]	6.14-17	0[c]	6.14-17
	Chemical Reduction	1	130,000	6.15-8	58	6.15-8

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Copper	Gravity Oil Separation	15 450[b]	6[h]	4.1-24 4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	32	<4	4.2-18	>99	4.2-19, 4.2-36, 4.2-45, 4.2-46, 4.2-47, 4.2-48, 4.2-51, 4.2-52, 4.2-53
	Clarification/Sedimentation with Chemical Addition (Alum)	4	<10[d]	4.3-23	81	4.3-25
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	31	4.3-31	80	4.3-35
	Clarification/Sedimentation with Chemical Addition (Lime)	16	<10	4.3-48	>99	4.3-52
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	9	12	4.3-68	>9	4.3-71
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	<20	4.3-37	73	4.3-38
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	10	4.3-74	98	4.3-74
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	<4	4.3-73	>89	4.3-73
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	2	13[a] 60	4.3-28 4.3-27	88	4.3-27
	Clarification/Sedimentation with Chemical Addition (Ferrous Sulfate, Lime)	6	4	4.3-40	92	4.3-44

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Copper (continued)	Gas Flotation (Dissolved Air Flotation)	2	5	4.4-5	69	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	660	4.5-5	19	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	5	150	4.5-9	91	4.5-9
	Gas Flotation with Chemical Addition (Polymer)	2	50^a 81	4.5-14 4.5-3	75	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	73	4.5-12	98	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	400^b	4.5-13	0^c	4.5-13
	Granular Media Filtration	35	<4	4.6-37	>99	4.6-13 4.6-17
	Ultrafiltration	3	<500 $<500^a$	4.7-13 4.7-14	>95	4.7-15
	Activated Sludge	37	<0.2	5.1-46, 5.1-52, 5.1-68	>99	5.1-46, 5.1-52, 5.1-68
	Trickling Filters	1	42^b	5.2-13	0^c	5.2-13
	Lagoon (Aerated)	5	5	5.3-15	94	5.3-18
	Lagoon (Tertiary)	1	18	5.3-25	0^c	5.3-25
	Granular Activated Carbon Adsorption	12	<4	6.1-38	>85	6.1-38

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Copper (continued)	Powdered Carbon Addition (With Activated Sludge)	3	7	6.2-9	96	6.2-8
	Chemical Oxidation	1	320	6.3-13	14	6.3-13
	Ion Exchange	2	90	6.7-10, 6.7-11	>99	6.7-10, 6.7-11
	Reverse Osmosis	17	9	6.9-14	>99	6.9-29
	Ozonation	2	89[b]	6.14-17	0[c]	6.14-16, 6.14-17
Lead	Gravity Oil Separation	13	4[h] 600[b]	4.1-33 4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	26	<5	4.2-63	>99	4.2-36, 4.2-41, 4.2-45, 4.2-48, 4.2-51, 4.2-52, 4.2-53, 4.2-54
	Clarification/Sedimentation with Chemical Addition (Alum)	3	23	4.3-23	18	4.3-23
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	66	4.3-31	>96	4.3-35
	Clarification/Sedimentation with Chemical Addition (Lime)	13	<3	4.3-59, 4.3-61	99	4.3-51
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	8	<20	4.3-71	95	4.3-71
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	30	4.3-38	83	4.3-38
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	<10[d]	4.3-74	>90	4.3-74

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Lead (continued)	Clarification/Sedimentation with Chemical Addition (Polymer)	2	<22[a]	4.3-73	97	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<200	4.3-27	50	4.3-27
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	1	<3	4.3-44	>96	4.3-44
	Gas Flotation (Dissolved Air Flotation)	2	2	4.4-6	82	4.4-6
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	1,000	4.5-5	0	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	6	67	4.5-8	98	4.5-9, 4.5-18, 4.5-19, 4.5-20
	Gas Flotation with Chemical Addition (Polymer)	2	<10[d]	4.5-15	>29	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	≤140	4.5-12	≥98	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	≤87	4.5-11	≥74	4.5-11
	Granular Media Filtration	31	5	4.6-17	>99	4.6-15
	Ultrafiltration	3	<1,000 <1,000[a]	4.7-13 4.7-14	>95	4.7-15
	Activated Sludge	26	0.6	5.1-48	99	5.1-48
	Trickling Filters	1	49[b]	5.2-13	0[c]	5.2-13

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Lead (continued)	Lagoon (Aerated)	2	<20	5.3-16	93	5.3-12
	Lagoon (Tertiary)	1	<10[d]	5.3-26	>72	5.3-26
	Granular Activated Carbon Adsorption	7	<22	6.1-41	>72	6.1-41
	Powdered Carbon Addition (With Activated Sludge)	2	<18	6.2-8	>78	6.2-8
	Chemical Oxidation	1	2,500[b]	6.3-13	0[c]	6.3-13
	Reverse Osmosis	11	<3[a] <3	6.9-9 6.9-10, 6.9-11	>99	6 9-29
	Ozonation	1	<22	6.14-17	>29	6.14-17
	Chemical Reduction	1	120,000	6.15-8	25	6.15-8
Mercury	Gravity Oil Separation	11	0.5[h]	4.1-26		
	Clarification/Sedimentation	20	<0.2	4.2-56	>99	4.2-56
	Clarification/Sedimentation with Chemical Addition (Alum)	2	1.7	4.3-23	>62	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	3	30	4.3-35	88	4.3-33
	Clarification/Sedimentation with Chemical Addition (Lime)	9	<0.2	4.3-61	>96	4.2-46

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Mercury (continued)	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	1	0.5	4.3-37	87	4.3-37
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	<0.3[a] 140	4.3-73 4.3-72	99	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	2	4.3-27	71	4.3-27
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	2	<0.2	4.3-44	>60	4.3-44
	Gas Flotation (Dissolved Air Flotation)	1	0.6	4.4-5	0[c]	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	1	4.5-5	33	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	3	<0.2	4.5-7, 4.5-8	>90	4.5-7
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	≤0.97	4.5-12	≥64	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	1.2	4.5-13	40	4.5-13
	Granular Media Filtration	8	0.3[a] <0.7	4.6-37 4.6-40	86	4.6-27, 4.6-28
	Ultrafiltration	[illegible]	0.4	4.7-14	20	4.7-14
	Activated Sludge	9	<0.5	5.1-43, 5.1-64	>87	5.1-43

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Mercury (continued)	Lagoon (Aerated)	1	0.1	5.3-16	>99	5.3-16
	Granular Activated Carbon Adsorption	2	0.4[b] 0.4	6.1-38 6.1-39	0[c]	6.1-38
	Powdered Carbon Addition (With Activated Sludge)	1	0.6	6.2-8	0[c]	6.2-8
	Reverse Osmosis	3	<0.2	6.9-11	>60	6.9-11
Nickel	Gravity Oil Separation	11	4[h] 500[b]	4.1-24 4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	24	<5	4.2-19	>99	4.2-19, 4.2-47 4.2-48, 4.2-50,
	Clarification/Sedimentation with Chemical Addition (Alum)	3	10[a] <40	4.3-23 4.3-16	>56	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	3	<50	4.3-35	>97	4.3-35
	Clarification/Sedimentaton with Chemical Addition (Lime)	13	2.2[a] 2.3	4.3-60 4.3-61	99	4.3-50
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	3	45	4.3-69	96	4.3-66
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	<10[d]	4.3-74	>80	4.3-74
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	<13	4.3-73	35	4.3-73
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<1	4.3-28	>83	4.3-28
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	5	<0.5	4.3-43, 4.3-45	>95	4.3-43, 4.3-45

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Nickel (continued)	Gas Flotation with Chemical Addition (Alum, Polymer)	1	270	4.5-5	41	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	5	<5	4.5-10	>94	4.5-10
	Gas Flotation with Chemical Addition (Polymer)	2	32[b]	4.5-15	0[c]	4.5-14, 4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	<5	4.5-12	>96	4.5-12
	Granular Media Filtration	16	<5	4.6-28	>99	4.6-13, 4.6-17, 4.6-28
	Ultrafiltration	1	<500	4.7-15	>32	4.7-15
	Activated Sludge	32	4	5.1-64	92	5.1-64
	Lagoon (Aerated)	3	30	5.3-12	50	5.3-12
	Granular Activated Carbon Adsorption	6	<36	6.1-7	68	6.1-8
	Powdered Carbon Addition (With Activated Sludge)	3	<10	6.2-8, 6.2-9	>58	6.2-8
	Ion Exchange	2	<10[e]	6 7-10	>99	6.7-10, 6.7-11
	Reverse Osmosis	13	<1	6.9-13, 6.9-14	>98	6.9-29
	Ozonation	2	66[b]	6.14-17	0[c]	6.14-16, 6.14-17
Nickel (dissolved)	Clarification/Sedimentation with Chemical Addition (Lime)	1	20	4.3-67	>99	4.3-67
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	2,500	4.3-65	99	4.3-65

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Selenium	Gravity Oil Separation	11	1 76[b]	4.1-33 4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	16	<2[a] <5	4.2-16 4.2-18, 4.2-45, 4.2-48, 4.2-50, 4.2-53, 4.2-58	>98	4.2-35, 4.2-46
	Clarification/Sedimentation with Chemical Addition (Lime)	5	2.3[b] 8	4.3-61 4.3-59	0[c]	4.3-46, 4.3-60 4.3-61, 4.3-62
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	<10	4.3-67	50	4.3-67
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	1	10[b]	4.3-37	0[c]	4.3-37
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	2	7[a] 32	4.3-41 4.3-45	24	4.3-41, 4.3-45
	Gas Flotation (Dissolved Air Flotation)	1	8.5[b]	4.4-5	0[c]	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	≤1	4.5-5	0	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	2[b]	4.5-6	0[c]	4.5-6
	Granular Media Filtration	6	<1	4.6-9	10	4.6-29
	Activated Sludge	1	41[b]	5.1-62	0[c]	5.1-62
	Lagoon (Aerated) Lagoon (Tertiary)	1 1	<200 18	5.3-16 5.3-25	>50 44	5.3-16 5.3-25
	Granular Activated Carbon Adsorption	4	<1	6.1-43	>50	6.1-43
	Powdered Carbon Addition (With Activated Sludge)	2	<20	6.2-9	>13	6.2-9
	Reverse Osmosis	4	<1[a] 2	6.9-10 6.9-14	85	6.9-12

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Silver	Gravity Oil Separation	2	1^h 250^b	4.1-33 4.1-5	0^c	4.1-5
	Clarification/Sedimentation	12	3^a <10	4.2-21 4.2-48, 4.2-50, 4.2-51, 4.2-52, 4.2-53, 4.2-54	>96	4.2-51, 4.2-53
	Clarification/Sedimentation with Chemical Addition (Alum)	2	72	4.3-65	10	4.3-65
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	11	4.3-31	21	4.3-31
	Clarification/Sedimentation with Chemical Addition (Lime)	6	0.4	4.3-59	>80	4.3-63
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	90^b	4.3-67	0^c	4.3-67
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	1	20^b	4.3-38	0^c	4.3-38
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	$<10^d$	4.3-74	>80	4.3-74
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	66	4.5-5	44	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	2	<15	4.5-8	>48	4.5-8
	Gas Flotation with Chemical Addition (Polymer)	1	29^b	4.5-14	0^c	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	<1	4.5-12	>75	4.5-12

(continued)

TABLE D-1 (continued

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Silver (continued)	Granular Media Filtration	12	<5	4.6-11, 4.6-38	>83	4.6-11
	Activated Sludge	17	<5	5.1-46, 5.1-47, 5.1-49, 5.1-51, 5.1-52, 5.1-53	>96	5.1-53
	Granular Activated Carbon Adsorption	6	<5^a 7	6.1-39 6.1-7	36	6.1-7
	Ion Exchange	2	<10^e	6.7-10	>99	6.7-10, 6.7-11
	Reverse Osmosis	13	<0.2	6.9-10	92	6.9-11
	Ozonation	2	16^b	6.14-17	0^c	6.14-16, 6.14-17
Thallium	Gravity Oil Separation	4	1	4.1-29		
	Clarification/Sedimentation	3	<5	4.2-19, 4.2-20 4.2-63	>83	4.2-63
	Clarification/Sedimentation with Chemical Addition (Lime)	3	<1	4.3-61	>88	4.3-61
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	4	<1	4.3-44	>88	4.3-44
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	50^b	4.5-6	0^c	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	14^b	4.5-15	0^c	4.5-15
	Activated Sludge	1	29	5.1-31	38	5.1-31
	Lagoon (Aerated)	2	13	5.3-20	>80	5.3-16
	Reverse Osmosis	3	1	6.9-12	89	6.9-12

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Zinc	Gravity Oil Separation	16	56[h] 680[b]	4.1-25 4.1-5	0[c]	4.1-5
	Clarification/Sedimentation	32	10	4.2-63	>99	4.2-45, 4.2-46, 4.2-48, 4.2-51, 4.2-53, 4.2-54,
	Clarification/Sedimentation with Chemical Addition (Alum)	4	110	4.3-23	85	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	244	4.3-31	83	4.3-32
	Clarification/Sedimentation with Chemical Addition (Lime)	15	<2	4.3-60, 4.3-61	>99	4.3-52, 4.3-55
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	9	25	4.3-69	>99	4.3-71
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	30	4.3-37, 4.3-38	80	4.3-32
	Clarification/Sedimentation with Chemical Addition (Sulfide)	1	90	4.3-74	97	4.3-74
	Clarification/Sedimentation with Chemical Addition (Polymer)	2	160	4.3-73	97	4.3-73
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	1,100	4.3-27	>99	4.3-27
	Clarification/Sedimentation with Chemical Addition (Ferrous sulfate, Lime)	6	<2	4.3-40, 4.3-44	>97	4.3-40, 4.3-44

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Zinc (continued)	Gas Flotation (Dissolved Air Flotation)	2	83	4.4-5	22	4.4-5
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	2,300	4.5-5	10	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	6	10[d]	4.5-9	>99	4.5-9
	Gas Flotation with Chemical Addition (Polymer)	2	<10	4 5-5	>60	4.5-15
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	130	4 5-12	95	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	910[b]	4.5-13	0[c]	4.5-13
	Granular Media Filtration	38	<10	4.6-27	>99	4.6-17
	Ultrafiltration	6	180	4.7-15	98	4.7-10, 4.7-15
	Activated Sludge	36	48[a] 68	5.1-62	92	5.1-25
	Lagoon (Aerated)	4	49	5.3-12	>99	5.3-16
	Lagoon (Tertiary)	2	100[b] 120	5.3-26	86	5.3-26
	Granular Activated Carbon Adsorption	18	<1	6.1-39	>99	6.1-39
	Powdered Carbon Addition (With Activated Sludge)	4	78[a] 110	6.2-10 6.2-8	98	6.2-8

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Zinc (continued)	Ion Exchange	1	400	6.7-11	97	6.7-11
	Reverse Osmosis	30	$<2^a$ <2	6.9-9, 6.9-10, 6.9-11	>99	6.2-27, 6.2-29
	Ozonation	3	90	6.14-9	96	6.14-9
	Chemical Reduction	1	1,500	6.15-8	97	6.15-8
Asbestos[f]	Clarification/Sedimentation	16	4.6×10^6	4.2-46	>99	4.2-45, 4.2-46, 4.2-47, 4.2-50, 4.2-51, 4.2-52, 4.2-53, 4.2-59
	Granular Media Filtration	8	8×10^4	4.6-26	>99	4.6-43, 4.6-46, 4.6-52, 4.6-55, 4.6-56
	Clarification/Sedimentation with Chemical Addition (Lime)	1	6.1×10^6	4.3-54	95	4.3-54
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	8.2×10^6	4.3-70	>99	4.3-70
	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	2	5.7×10^8	4.3-37	75	4.3-37
Asbestos (chrysotile)[f]	Clarification/Sedimentation	12	3.3×10^5	4.2-54	>99	4.2-54
	Granular Media Filtration	3	1×10^5	4.6-53	>99	4.6-51, 4.6-53, 4.6-54

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, μg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Total chlorine	Solvent Extraction	11	1,800	5.6-10	99	5.6-10
Fluoride	Clarification/Sedimentation	1	320	4.2-32	51	4.2-32
	Clarification/Sedimentation with Chemical Addition (Lime)	3	2,500	4.3-74	98	4.3-67
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	130,000	4.3-69	92	4.3-69
Oil and grease	Gravity Oil Separation	23	11,900^h 1,350,000	4.1-16 4.1-5	27	4.1-5
	Clarification/Sedimentation	19	2,700	4.2-24 4.2-25	99	4.2-36
	Clarification/Sedimentation with Chemical Addition (Alum)	1	11,000	4.3-21	99	4.3-21
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	4	4,000	4.3-31	99	4.3-33
	Clarification/Sedimentation with Chemical Addition (Lime)	2	1,000	4.3-49	66	4.3-49
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	3	4,000	4.3-68	94	4.3-67
	Clarification/Sedimentation with Chemical Addition (Polymer)	1	22,000	4.3-72	98	4.3-72
	Clarification/Sedimentation with Chemical Addition (Alum, Lime)	1	<16,000	4.3-27	>98	4.3-27

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Oil and grease (continued)	Gas Flotation (Dissolved Air Flotation)	1	220^b	4.4-5	0^c	4.4-5
	Gas Flotation with Chemical Addition (Alum)	4	$<10,000^d$	4.5-22	>99	4.5-22
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	$76,000^a$	4.5-5	63	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	6	53,000	4.5-11	90	4.5-11
	Gas Flotation with Chemical Addition (Polymer)	1	16,000	4.5-14	59	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	28,000	4.5-12	97	4.5-12
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	101,000	4.5-13	70	4.5-13
	Gas Flotation with Chemical Addition (Lime, Polymer)	1	190,000	4.5-16	66	4.5-16
	Granular Media Filtration	13	<500	4.6-18	>98	4.6-18
	Ultrafiltration	11	$5,000^a$ <9,000	4.7-16 4.7-12	>99	4.7-15
	Activated Sludge	7	<5,000	5.1-21	>98	5.1-21
	Lagoon (Aerated)	1	17,000	5.3-12	98	5.3-12
	Rotating Biological Contactors	5	13,000	5.4-6	21	5.4-6

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Oil and grease (continued)	Granular Activated Carbon Adsorption	10	2,200	6.1-8	92	6 1-8
	Powdered Carbon Addition (With Activated Sludge)	4	9,000	6.2-6	96	6.2-8
	Reverse Osmosis	5	ND	6 9-29	>72	6.9-29
	Ozonation	1	4,000	6.14-9	97	6.14-9
Total phosphorus	Clarification/Sedimentation	1	13,900	4.2-21	3	4.2-21
	Clarification/Sedimentation with Chemical Addition (Alum)	2	2,300	4.3-65	15	4.3-65
	Clarification/Sedimentation with Chemical Addition (Alum, Polymer)	1	1,600	4.3-31	77	4.3-31
	Gas Flotation with Chemical Addition (Alum, Polymer)	1	12,200	4.5-5	49	4.5-5
	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	2	1,700	4.5-6	96	4.5-6
	Gas Flotation with Chemical Addition (Polymer)	1	1,000[b]	4.5-14	0[c]	4.5-14
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1[a]	140	4.5-5	99	4.5-5
	Gas Flotation with Chemical Addition (Ferrous sulfate, Polymer)	1	300	4.5-13	98	4.5-13

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Total phosphorus (continued)	Granular Media Filtration	7	230	4.6-44	83	4.6-9
	Activated Sludge	27	150	5.1-69	97	5.1-69
	Rotating Biological Contactors	5	3,000	5.4-6	21	5.4-6
	Granular Activated Carbon Adsorption	4	1,000	6.1-42	57	6.1-42
	Ozonation	1	1,100	6.14-17	0	6.14-17
Aluminum	Clarification/Sedimentation with Chemical Addition (Lime)	2	200	4.3-50	98	4.3-50
Iron	Clarification/Sedimentation with Chemical Addition (Lime)	2	300	4.3-50	>99	4.3-50
Manganese	Clarification/Sedimentation with Chemical Addition (Lime)	1	200	4.3-50	99	4.3-50
Molybdenum	Ion Exchange	1	1,290	6.7-12	94	6.7-12
Acetaldehyde	Lagoon (Anaerobic)	3	10	5.3-22	67	5.3-22
Acetic acid	Lagoon (Anaerobic)	3	220	5.3-22	0^c	5.3-22
Acetone	Solvent Extraction	3	12,000	5.6-16	57	5.6-18
Ammonia-Nitrogen	Chemical Oxidation	1	124	6.3-12	36	6.3-12
	Air Stripping	1	41,000	6.4-6	90	6.4-6

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Butyric acid	Lagoon (Anaerobic)	2	300	5.3-22	0^c	5.3-22
Calcium	Clarification/Sedimentation with Chemical Addition (Lime)	1	230,000	4.3-50	58	4.3-50
Chloride	Clarification/Sedimentation with Chemical Addition (Lime)	1	19×10^6	4.3-75	26	4.3-75
Chromium(+3)	Granular Media Filtration	1	610	4.6-12	95	4.6-12
	Reverse Osmosis	1	15	6.9-29	>99	6.9-29
Chromium(+6)	Clarification/Sedimentation	1	5	4.2-21	0	4.2-21
	Granular Media Filtration	3	10	4.6-9	98	4.6-9
	Powdered Carbon Addition (With Activated Sludge)	3	<20	6.2-6, 6.2-8	>64	6.2-6
	Ion Exchange	1	10	6.7-11	>99	6.7-11
	Reverse Osmosis	1	10^b	6.9-29	0^c	6.9-29
Chromium (dissolved)	Clarification/Sedimentation with Chemical Addition (Lime)	1	40	4.3-49	>99	4.3-40
	Clarification/Sedimentation with Chemical Addition (Lime, Polymer)	1	1,300	4.3-65	99	4.3-65

(continued)

TABLE D-1 (continued)

Pollutant	Pollution treatment technology	Number of data points	Lowest observed effluent concentration, µg/L	Volume III page(s)	Highest observed removal efficiency, %	Volume III page(s)
Dichlorobenzene	Gas Flotation with Chemical Addition (Calcium chloride, Polymer)	1	260	4.5-6	76	4.5-6
	Gas Flotation with Chemical Addition (Ferrous sulfate, Lime, Polymer)	1	18[b]	4.5-12	0[c]	4.5-12
Methyl ethyl ketone	Solvent Extraction	7	12,000	5.6-18	95	5.6-18
m,p-Cresol	Solvent Extraction	1	25,000	5.6-8	91	5.6-8
o-Cresol	Solvent Extraction	9	2,300	5.6-15	>99	5.6-15
Propionic acid	Lagoon (Anaerobic)	2	470	5.3-22	0[c]	5.3-22
Radium (dissolved)	Clarification/Sedimentation with Chemical Addition ($BaCl_2$)	3	<0.9 <2	4.3-38 4.3-50	94	4.3-39
	Ion Exchange	1	<1	6.7-13	>99	6.7-13
Radium$_{226}$[g] (total)	Clarification/Sedimentation with Chemical Additon ($BaCl_2$)	5	1.1	4.3-38	>99	4.3-38
Radium[g] (total)	Ion Exchange	1	7.2	6.7-13	99	6.7-13
Styrene	Solvent Extraction	1	<1,000	5.6-14	>93	5.6-14
Xylene	Trickling Filters	1	2	5.2-13	0[c]	5.2-13
	Solvent Extraction	3	<1,000	5.6-11, 5.6-12	>98	5.6-11

---

[a] The removal efficiency associated with this sample was less than the median.

[b] The effluent concentration reported was higher than the influent concentration for the pollution control device tested.

[c] Actual data indicate negative removal.

[d] The concentration was reported as "not detected."

[e] The concentration was reported as "below detection limits."

[f] Units given in fibers/L.

[g] Units given in picoCi/L.

[h] No removal efficiencies were reported.

☆U.S. GOVERNMENT PRINTING OFFICE: 1980-325-158/6393